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An Assessment of American plaice in NAFO Subdivision 3PS

Évaluation de la plie canadienne de la sous-division 3Ps de l'OPANO

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ABSTRACT

The stock of American plaice in Subdivision 3Ps has been under moratorium since September 1993. Catches averaged just under 4,000 t during the 1980's but rapidly declined after 1991. There has been no directed fishery since the moratorium was instituted. Indices of abundance and biomass showed a large decline from the mid 1980's to 1990. Since 1992 stock size has been very low. There has been a slight increase over the 1992-2005 time period in both biomass and abundance indices but average biomass over the last 3 years is only 20% and abundance 26% of the 1983-87 average. Year class strength has declined since 1998 and the 2002 year class is the third lowest in the time series. Catch increased substantially since 1995, and was over 1,000 t in each year from 2001 to 2003. Catch to survey biomass ratios indicate that exploitation rate has been increasing since the mid 1990's. Catch to survey biomass ratios have continued to increase although catch declined somewhat in 2003 and 2004. This is the result of a somewhat lower exploitable biomass. The 1998 and 1999 year classes are near average and may result in some increase in the exploitable biomass over the short term. However they are followed by several below average year classes. Although there is variability at low stock size, there is a fairly clear stock recruit relationship. A changepoint regression analysis estimates that an SSB index of about 13.6 gives a recruitment that is 50% of the maximum estimated. The SSB index is currently at 10 (average of 8.6 over last 3 years) and has been below 13.6 since the early 1990's. The SSB index is therefore at a level that suggests that recruitment will be less than half of its maximum potential. Catches at recent levels are contributing to the lack of recovery.

RÉSUMÉ

Le stock de plie canadienne de la sous-division 3Ps est sous le coup d'un moratoire depuis septembre 1993. Les prises atteignaient en moyenne un peu moins de 4 000 t pendant les années 1980, mais ont rapidement diminué après 1991. Aucune pêche dirigée n'a eu lieu depuis la mise en place du moratoire. Les indices de biomasse et d'abondance ont connu une forte baisse à partir du milieu des années 1980 jusqu'en 1990. Depuis 1992, la taille du stock est très faible. Les indices de biomasse et d'abondance ont légèrement augmenté entre 1992 et 2005, mais la biomasse et l'abondance moyennes au cours des trois dernières années ne s'établissaient respectivement qu'à 20 % et 26 % de la moyenne pour 1983-1987. L'effectif des classes d'âge est en baisse depuis 1998 et la classe de 2002 est la troisième plus basse de la série chronologique. Les prises ont augmenté substantiellement depuis 1995 et ont dépassé 1 000 t, chaque année, entre 2001 et 2003. Les rapports entre les prises et la biomasse établie par relevés indiquent que le taux d'exploitation augmente depuis le milieu des années 1990. Ces mêmes rapports ont continué d'augmenter, bien que les prises aient diminué quelque peu en 2003 et 2004. Cette situation résulte d'une biomasse exploitable un peu plus basse. Les classes d'âge de 1998 et 1999 sont près de la moyenne et pourrait entraîner une légère augmentation de la biomasse exploitable à court terme. Toutefois, elles sont suivies de plusieurs classes inférieures à la moyenne. Bien qu'on constate une variation à un faible niveau de la taille du stock, il existe une relation très claire avec le recrutement au sein du stock. Une analyse de régression du point de virage révèle qu'un indice de la BSR d'environ 13,6 donne un recrutement qui correspond à 50 % du maximum prévu. L'indice de la BSR se situe actuellement à 10 (moyenne de 8,6 pour les trois dernières années) et a été de moins de 13,6 depuis le début des années 1990. Il est donc à un niveau qui porte à croire que le recrutement sera inférieur à la moitié de son potentiel maximal. Les prises aux niveaux récents contribuent à la faiblesse du rétablissement.

Description of the Fishery

Catches from this stock were highest from 1968 to 1973, exceeding 12,000 t on three occasions in this period (Fig. 1, Table 1). Catches by non-Canadian vessels peaked at about 8,800 t in 1968, due mainly to the USSR catch, and have not exceeded 800 t since 1973. Since 1977 only Canada and France have been involved in this fishery. Catches averaged just under 4,000 t during the 1980's but rapidly declined after 1991. Based on a recommendation by the FRCC the fishery was closed in September of 1993 for the remainder of that year. Since that time catch is supposed to be bycatch only. Catch increased substantially since 1995, and was over 1,000 t in each year from 2001 to 2003. The catch to September 2005 was 500 t.

Data from the Newfoundland reported catch statistics (ZIFF) were examined to determine which fisheries were taking the greatest portion of the American plaice bycatch. The bycatch of American plaice is taken in two main fisheries, the directed cod and the directed witch flounder fisheries. Since 1999 the bycatch of plaice as a percentage of the directed species has been over 20 % in the witch flounder fishery (Table 2). In the cod fishery it was less than 5% overall, except for 2002 when the percentage was 6.5. During this period 1/4 to 1/3 of the total American plaice catch has come from the witch flounder fishery. At the same time the TAC for cod has ranged from 15,000 to 30,000 t while the quota for witch flounder has been 650 t. For data where main species sought was recorded as witch flounder, catches came from the otter trawl and Danish seine fleets. The bycatch percentage in the otter trawl fishery has been extremely high and in 2000 and 2001 more American plaice was caught than witch flounder in that fishery (Table 3). The directed witch fishery using Danish seines has had a much lower bycatch percentage, generally 5% or less. In 2003 and 2004 the percentage bycatch in the otter trawl fishery declined but was still 49% in 2004.

Length and age compositions from commercial fisheries

Length frequency data were collected from various fisheries on American plaice in Subdiv. 3Ps during 2002-2004. Otoliths were also collected during these years. Despite the predominance of fixed gear landings each year, the only year with samples from these gear sectors was 2004, when some length frequencies were collected from gillnet catches. Most of the available length frequencies were collected by observers and port samplers, from American plaice caught in other directed fisheries, primarily the Canadian otter trawl (OT) fishery for witch flounder in the first quarter of each year. Other sampled fisheries include the Canadian and French otter trawl fisheries for cod, and the Canadian large-mesh otter trawl fishery for skate, all of which take American plaice as a by-catch.

Table 4 shows the catch at age, and mean lengths and weights at age calculated from the samples collected during 2002 to 2004. The 2002 data were updated with recent catch estimates, and were similar to the preliminary calculations in the 2002 assessment. Age 9 was dominant in each year, and the mean weight per fish ranged from 0.63 kg (2004) to 0.72 (2003). Mean weights at ages younger than 11 generally showed an increase over the 3 years. However, it should be noted that the lack of fixed gear samples means that the age compositions and weights at age reflect the otter trawl catch. Based on previous comparisons, eg. Morgan et al 2002, it is highly probable that the age compositions calculated for 2002 to 2004 underestimate the numbers of older fish and overestimate the numbers of younger fish in the catches.

The number of larger fish in the catches in recent years remains lower than in the years prior to the mid 1990's. This is readily seen in Fig 2, which shows a comparison of length frequencies from 1990, 1998, and 2004, first quarter Can (N) otter trawl catches. There has been a reduction in the length of the largest fish, both male and female, observed in the commercial catches since the early 1990's, with the largest fish in catches during 2000-04 being 10-20 cm smaller than the largest fish from catches in the mid 1980's (Fig. 3). Corresponding to the reduction in the catches of larger males was an increase in the percentage of females in the catches, from around 70% in 1983-93 to over 85% from 1994 to 2001. As noted in Morgan et al. (2002), the most likely cause of this shift was the adoption of a minimum mesh size of 145 mm by the Canadian otter trawlers, which was required as a result of conservation harvesting plans (CHP's) introduced in 1994. Prior to this, the regulated minimum mesh size was 130 mm, and more male fish would have been caught by this mesh size. Although there has been a declining trend in the percentage of females since 1996, recent values are still above those observed in 1988-93 (Fig. 4). Some of the differences may also be due to the change in the nature of the fishery since 1993 (by-catch vs. directed), as well as the reduced sampling in the latter period. In any case, it is clear from available data that length compositions after 1993 are much different than those observed previously.

In previous assessments of this stock (Morgan et al 1999, 2002), it was concluded that there have been major changes in the commercial fisheries and the resulting length compositions taken from these fisheries during the 1990's, and therefore it was not advisable to apply historic length and age compositions to the recent catch data. Minimal sampling of fixed gear catches is available after 1993, even though these gears took the majority of catches since then. In addition, no otolith readings are available for this stock for the period 1994 to 1999. For these reasons, it is not possible to construct representative catch at age for American plaice in Subdiv. 3Ps for the years 1994-99 with available data. As well, noting in particular the lack of samples from the fixed gear fisheries, considerable uncertainty exists regarding the catch at age calculated for 2000 to 2004.

Research Vessel Surveys

Stratified-random surveys have been conducted by Canada in Subdivision 3Ps in each year from 1972 to 2005, based on the stratification scheme shown in Figure 5. Coverage prior to 1980 was poor. There were two surveys in 1993, one in February and one in April. Most of the surveys prior to 1993 were in February/March, while those since 1993 have been in April. The data can be split into three time periods based on the trawl used in each period: 1971-82 was Yankee 36, 1983-95 was Engel 145 and 1996-2005 was Campelen 1800 (see McCallum and Walsh (1996) for a description of the various trawls). There is a conversion between the second and third survey gears (Morgan et al. 1999) but not the first and third. Therefore, abundance and biomass indices in this document are reported from 1983 to 2005.

Current survey indices have been compared with the 1983-1987 time period throughout the document. This is the beginning of the Campelen or equivalent time series. The previous Engel time series showed that the 1980's were a period of relative stability with the 1983-1987 portion of the decade being about average. The area was surveyed in the 1970's but areal coverage was so poor that results are not comparable with the later surveys.

Trends in Biomass and Abundance

Biomass and abundance indices from 1983-2005 are shown in Figure 6. Mean number and weight per stratum for 1996-2005 are given in Tables 5 and 6. From the mid 1980's to 1990 there was a large decline in the indices. Since 1992 stock size has been very low. There has been a slight increase over the 1992-2005 time period in both biomass and abundance indices but average biomass over the last 3 years is only 20% and abundance 26% of the 1983-87 average. For only the 7+, or exploitable, portion of the survey index, the biomass is 17% (Figure 7) and the abundance 12% of the 1983-87 average (Table 7).

Surveys have been conducted by industry (GEAC) in November/December since 1998. This survey shows an increase in biomass to 2001 and then a lower level since (McClintock 2002 and pers com). Although there seems to be some overall correspondence between the research vessel and GEAC survey there is no significant correlation between the two (Fig. 8, $r=0.6$, $p=0.2$). However there are only 7 points to compare.

Abundance at age from 1983-2002 is given in Table 7. From 1994 to 1997 there were no fish older than age 14. The percentage of 9+ fish was extremely low in 1996 and 1997 then returned to average levels until 2003. The percentage of fish in the 9+ category was below average in 2004 and 2005. The oldest age in the survey was 17 or greater in each of the last 6 years.

American plaice are distributed throughout Subdivision 3Ps (Fig. 9 & 10). There were few sets that contained no fish. In most years the area of highest concentration appeared to be the eastern portion of the Subdivision and along the western slope of St. Pierre Bank, mainly in strata 315-323 (Table 5 and 6). There has been little change in distribution since 1996.

Mortality

Estimates of total mortality (log(n/n+1)) from the Campelen or equivalent survey data were calculated for ages 2 to 17 (Figure 11, Table 8). A Lowess smoother has been added to the plots to help visualize trends. For most ages mortality increased until the early to mid 1990's before declining in recent years. The average mortality on ages 6-13 in 1994-95 was –1.0, despite very low catches.

Abundance at age for ages 5 to 17 from the GEAC survey were used to produce another estimate of mortality. Since this survey occurs at the end of the year the change in number in year n at age a to number in year n+1 at age a+1 was taken to represent mortality on age a+1 in year n+1. For example the change in number from age 5 in 1998 to age 6 in 1999 was taken as an estimate of mortality on age 6 in 1999. The results are shown in Figure 12. Fish are not fully recruited to the gear until at least age 9. For most of the ages, there is an increase in mortality over the 1999 to 2004 time period.

Mean Length and Weight at Age

Mean lengths and weights at age by sex were calculated from survey data for 1983-2005 and 1990-2005 respectively. Means were calculated accounting for the length stratified sampling design. The results are presented in Figures 13 and 14. There appears to be some increase in mean length at age over the time period particularly for females. There is little indication of any consistent trend over time in the shorter mean weight at age time series.

Maturities

Age and length at 50% maturity were estimated from survey data. Estimates of proportion mature at each age were also produced for use in spawning stock biomass calculations. Proportion mature at age was calculated according to the method of Morgan and Hoenig (1997) accounting for the length stratified sampling design. All estimates were produced by cohort.

A_{50} for both males and females has declined (Fig. 15). There was a significant difference in proportion mature at age across cohort for both males (χ^2=549.7, df=34, p<0.0001) and females (χ^2=1343..1, df=37, p<0.0001) The current A_{50} for males is about 4 years compared to 7 years at the beginning of the time series. For females the current A_{50} is about 8 years compared to 11 years for the earliest cohorts in the time series.

There was a significant effect of cohort on L_{50} for both sexes (males: χ^2=1007.1, df=34, p<0.0001; females: χ^2=664.8, df=37, p<0.0001) (Fig. 16). The current L_{50} for males is 17-19 cm compared to 27 cm at the beginning of the time series and for females it is 36-37 cm compared to 40 cm.

Spawning Stock Biomass

Female spawning stock biomass (SSB) was calculated using survey data from 1983 to 2005. The estimates of maturity and mean weight at age described above were used, along with female abundance at age. When estimates of mean weight at age were not available for a given age in a given year, the average of the observations for that age were used.

SSB trends are very similar to those for the biomass index as a whole (Fig. 17). The female SSB index showed a large decline from the mid 1980's to the early 1990's and has shown a slight increase since 1997. The SSB index from 2003-2005 is 25% of the 1983-1987 average.

Recruitment

A model estimating cohort strength using Campelen or equivalent data showed pattern in the residuals. Therefore cohort strengths were estimated using the following model using Engel data from 1983-95 and Campelen from 1996 to 2005:

$$\log(N_{s,a,y}) = \mu + Y_y + (SA)_{s,a} + \varepsilon_{s,a,y},$$

where:

μ = intercept

s = survey subscript, Engel or Campelen

a = age subscript, age 2 to 5

y = cohort subscript

N = Index (Abundance in millions)

Y = cohort effect

SA = Survey * Age effect, and

ε = residuals from the fitted model.

Only those cohorts that were observed at least twice in the data were used. This model had no obvious pattern in the residuals (Fig.18) and a significant cohort effect.

R^2=0.93, n=78

Source		DF	Type III SS	F value	Pr>F
COHORT	23	28.9	2.12	0.02	
AGE*SURVEY	7	138.5	33.27	0.0001	

Cohort strength declined from the 1979 to the 1995 year class. Cohort strength then increased to 1998 and then declined to 2002. The 2002 cohort is the third lowest in the time series.

Precautionary Reference Points

The estimates from the relative cohort strength model were used to produce recruitment in terms of numbers of 5 year olds. A changepoint regression model using the numerical optimization approach outlined by Julious (2001) was fit to the stock recruit data. Changepoint regression, also referred to as segmented regression and "hockey-stick" has been considered by Barrowman and Myers (2000) and in the context of B_{lim} estimation by O'Brien et al. (2003). The changepoint regression model is

$$R = \alpha S e^{\varepsilon} \text{ when } 0 \le S \le \delta, \text{ and}$$
$$= \beta e^{\varepsilon} \text{ when } S \ge \delta.$$

On the logarithmic scale, this becomes

$$\log R = \log \alpha + \log S + \varepsilon \text{ when } 0 \le S \le \delta, \text{ and}$$
$$= \log \beta + \varepsilon \text{ when } S \ge \delta.$$

α and δ, and hence β ($\alpha\delta$=β) were estimated by applying the sequence of steps comprising the Julious Algorithm. .

A reference point suggested by Mace (1994) was applied to the results of the changepoint regression model. This reference point is the SSB which produces 50% of the maximum recruitment estimated from a S/R curve. In the context of a Beverton-Holt model, below this reference level recruitment declines rapidly with further spawner biomass reduction and can be considered a reference point below which productivity is impaired, and thus it can be considered a limit reference point (Shelton and Rice, 2002). . In the changepoint regression $B_{\lim} = \frac{1}{2}\hat{\delta}$

Although there is variability at low stock size, there is a fairly clear stock recruit relationship (Fig. 19). The changepoint regression analysis estimates that an SSB index of about 13.6, gives a recruitment that is 50% of the maximum estimated. The SSB index is currently at 10 (average of 8.6 over last 3 years) and has been below 13.6 since the early 1990's. A PA-compliant management approach should ensure a

low probability (less than 10%) of being below B_{lim} before considering a directed fishery. This would require consideration of the uncertainty in B_{lim}, uncertainty in current stock size and uncertainty in projected stock size under TAC options.

To examine the fit of the model a bootstrap was conducted by randomly selecting stock recruit pairs from the data, with replacement 5000 times. The bootstrap CV is 25% indicating a relatively well defined B_{lim}. 90% confidence intervals for B_{lim} range from 7.7 to 16.2. The bootstrap mean was slightly smaller than the estimate indicating a small bias. The effect of possible influential data points could be examined further with a jack knife analysis.

Catch to Survey Biomass

As a proxy for fishing mortality on this stock, the ratio of catch to biomass from Canadian research vessel surveys was examined from Campelen data from 1983 to 2005 (Fig. 20). Catch/biomass ratio increased steadily through the 1980's reaching a peak of 0.31 in 1990. It declined rapidly after that as catches decreased, and reached a minimum in 1995. Since then there has been a fairly steady increase in C/B. Levels of the last few years are similar to those in the early to mid 1980's when there was a directed fishery on this stock.

The biomass in the 1990 survey of 3Ps was low compared to 1989 and 1991. This may have artificially inflated the estimate of the C/B ratio in that year. If the biomass in 1990 is estimated to be between those of the adjacent years then the C/B ratios in that year would be 0.14.

Assessment

Indices of abundance and biomass showed a large decline from the mid 1980's to 1990. Since 1992 stock size has been very low. There has been a slight increase over the 1992-2005 time period in both biomass and abundance indices but average biomass over the last 3 years is only 20% and abundance 26% of the 1983-87 average. Year class strength has declined since 1998 and the 2002 year class is the third lowest in the time series. Catch increased substantially since 1995, and was over 1,000 t in each year from 2001 to 2003. Catch to survey biomass ratios indicate that exploitation rate has been increasing since the mid 1990's. Catch to survey biomass ratios have continued to increase although catch declined somewhat in 2003 and 2004. This is the result of a somewhat lower exploitable biomass. The 1998 and 1999 year classes are near average and may result in some increase in the exploitable biomass over the short term. However they are followed by several below average year classes. Although there is variability at low stock size, there is a fairly clear stock recruit relationship. A changepoint regression analysis estimates that an SSB index of about 13.6 gives a recruitment that is 50% of the maximum estimated. The SSB index is currently at 10

(average of 8.6 over last 3 years) and has been below 13.6 since the early 1990's. The SSB index is therefore at a level that suggests that recruitment will be less than half of its maximum potential. Catches at recent levels are contributing to the lack of recovery.

Although most of the catch has come from cod directed fisheries, in the last 6 years 25 to 30 percent of the total American plaice catch has been taken in the directed witch flounder fishery being conducted by the otter trawl fleet. While the allowable bycatch of American plaice in this fishery is 50%, compared to 10% in other fisheries, actual bycatch rates have been in the range of 49 to 143% in the last 6 years. If bycatch in this fishery were limited to levels similar to other fisheries, the total catch of American plaice could decrease by more than 20%. This should result in increased prospects for stock rebuilding.

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Table 1. Catches (1960-2005) and TACs (1974-2005) of American plaice in NAFO Subdivision 3Ps. All values in metric tons.

Year	Canada			France	USSR	Other	Total	TAC
	Nfld	M&Q	Total					
1960	422	405	827	60	-	-	887	-
1961	764	660	1,424	31	-	-	1,455	-
1962	659	363	1,022	2	-	-	1,024	-
1963	504	25	529	208	1	16	754	-
1964	1,132	230	1,362	152	-	28	1,542	-
1965	574	1,275	1,849	162	-	11	2,022	-
1966	1,162	1,332	2,494	667	218	27	3,406	-
1967	2,201	1,074	3,275	533	678	8	4,494	-
1968	4,007	1,516	5,523	524	8,233	-	14,280	-
1969	2,888	1,178	4,066	245	2,180	-	6,491	-
1970	7,368	4,227	11,595	397	336	-	12,328	-
1971	4,667	1,286	5,953	820	409	-	7,182	-
1972	4,301	1,621	5,922	383	220	13	6,538	-
1973	10,972	1,840	12,812	547	1,368	42	14,769	-
1974	5,887	443	6,330	268	-	-	6,598	11,000
1975	2,517	1,301	3,818	65	128	200	4,211	11,000
1976	5,302	128	5,430	5	9	14	5,458	8,000
1977	4,235	307	4,542	63	-	-	4,605	6,000
1978	3,419	192	3,611	47	-	-	3,658	4,000
1979	3,405	187	3,592	74	-	-	3,666	4,000
1980	2,516	213	2,729	206	-	-	2,935	5,000
1981	2,703	57	2,760	457	-	-	3,217	5,000
1982	1,823	46	1,869	317	-	-	2,186	5,000
1983	1,421	83	1,504	222	-	-	1,726	5,000
1984	2,487	138	2,625	338	-	-	2,963	5,000
1985	3,608	206	3,814	406	-	-	4,220	5,000
1986	4,367	98	4,465	665	-	-	5,130	5,000
1987	4,669	119	4,788	543	-	-	5,331	5,000
1988	3,745	56	3,801	605	-	-	4,406	5,000
1989	3,102	96	3,198	759	-	-	3,957	5,000
1990	3,880	226	4,106	739	-	-	4,845	4,000
1991	3,982	76	4,058	337	-	-	4,395	4,000
1992	2,380	290	2,670	9	-	-	2,679	4,000
1993	723	57	780	-	-	-	780	3,000
1994	112	11	123	-	-	-	123	500[b]
1995	80	10	90	-	-	-	90	100[b]
1996	112	3	115	-	-	-	115	100[b]
1997	213	7	220	23	-	-	243	100[b]
1998	405	2	407	16	-	-	423	0
1999	615	14	629	25	-	-	654	0
2000	609	1	610	40	-	-	650	0
2001[a]	884	24	908	102	-	-	1010	0
2002[a]	1011	5	1016	112	-	-	1128	0
2003[a]	882	20	902	131	-	-	1033	0
2004[a]	736	10	746	72	-	-	818	0
2005[a,c]	489	14	503	0	-	-	503	0

[a]Provisional
[b]By-catch
[c]Data for 2005 are incomplete

Table 2. Weight of American plaice caught (t), percentage American plaice of the main species sought, and percentage of the overall American plaice catch for the year, where main species sought was identified as witch flounder or cod. Data are for Newfoundland vessels only.

	Tons of plaice	% bycatch	% of total plaice catch for year
Witch directed			
1999	184	37	28
2000	203	66	31
2001	243	65	24
2002	304	67	30
2003	235	51	27
2004	152	35	21
Cod directed			
1999	442	2	68
2000	335	2	52
2001	478	4	47
2002	568	5	56
2003	530	5	60
2004	489	5	66

Table 3. Weight of American plaice caught (t) and percentage of main species sought for data where witch flounder was identified as the directed species for the otter trawl and Danish seine fleets. Data are for Newfoundland vessels only.

	Tons of plaice	% bycatch
Otter trawl fleet		
1999	118	46
2000	200	143
2001	235	101
2002	296	92
2003	229	72
2004	146	49
Danish seine fleet		
1999	6	3
2000	3	2
2001	8	6
2002	8	6
2003	6	4
2004	6	5

Table 4. Catch at age (000 s of fish), mean lengths (cm) and weights (kg) of American plaice caught in Subdiv. 3Ps during 2002-2004.
SOP is the sum of products, in tons, of the catch number X mean weight.

	2002	Mean			**2003**	Mean			**2004**	Mean		
Age	Catch	Length	Weight	SOP	Catch	Length	Weight	SOP	Catch	Length	Weight	SOP
3									0.1	22.5	0.088	0.01
4									0			0.0
5									8	34.2	0.356	2.8
6					83	38.3	0.519	43.1	43	33.2	0.323	13.9
7	23	34.1	0.349	8.0	76	36.9	0.472	35.9	137	35.4	0.401	54.9
8	196	35.1	0.396	77.6	170	36.8	0.466	79.2	255	37.0	0.468	119.3
9	407	37.1	0.473	192.5	333	38.0	0.512	170.5	372	38.1	0.518	192.7
10	280	38.7	0.540	151.2	257	40.0	0.608	156.3	147	40.7	0.639	93.9
11	364	42.6	0.741	269.7	248	43.5	0.797	197.7	139	42.7	0.750	104.3
12	206	45.7	0.934	192.4	112	46.5	0.999	111.9	70	46.5	0.999	69.9
13	101	48.5	1.136	114.7	95	48.2	1.290	122.6	59	48.6	1.152	68.0
14	48	51.7	1.407	67.5	51	52.7	1.510	77.0	42	50.4	1.303	54.7
15	15	55.0	1.763	26.4	16	57.0	1.942	31.1	16	54.0	1.644	26.3
16	8	58.4	2.106	16.8	6	57.6	2.013	12.1	5	56.0	1.815	9.1
17	5	60.2	2.329	11.6	2	60.7	2.390	4.8	3	57.2	1.950	5.9
18	1	58.5	2.100	2.1					1	59.2	2.195	2.2
19	0.3	66.5	3.216	1.0								
	1654.3			1131.8	1449			1042.0	1297.1			817.9
		Catch = 1128 t				Catch = 1033 t				catch=818 t		
Mean wt/fish		0.68413				0.719086				0.630599		

Table 5. Mean number per tow and number of sets, by stratum, from Canadian RV surveys in Subdivision 3Ps from 1996 to 2005.

		Year	1996		1997		1998		1999		2000	
Depth range	Stratum	Units	Number	Sets	Number	Sets	Number	Sets	Number	Sets	Number	Sets
<=56	314	133984	2.00	8	0.14	7	5.51	7	15.19	8	9.00	7
	320	181581	14.43	10	0.67	9	9.64	11	19.63	8	15.00	11
57 - 91	293	21872	-	-	0.44	2	0.89	2	2.00	2	4.50	2
	308	15407	2.00	2	2.00	2	1.00	2	33.00	2	13.00	2
	312	37417	15.33	3	0.50	2	9.33	2	11.89	2	8.89	2
	315	113763	61.57	6	5.00	6	41.86	7	38.24	7	142.00	7
	321	163560	11.67	9	13.91	9	7.30	10	23.63	9	58.20	10
	325	129858	10.38	9	50.17	6	23.86	8	52.01	8	52.00	8
	326	22835	12.50	2	5.00	2	11.00	2	22.33	2	12.72	2
	783	31501	-	-	0.00	2	0.44	2	1.00	2	3.50	2
93 - 183	294	18571	-	-	1.50	2	10.33	2	7.50	2	31.78	2
	297	20909	-	-	16.00	2	15.50	2	12.11	2	23.21	2
	307	54337	2.17	4	0.00	3	3.56	3	15.38	3	4.00	3
	311	43607	29.00	3	36.50	2	64.74	3	29.19	3	347.00	3
	317	26549	148.00	2	25.50	2	164.00	2	104.00	2	513.00	2
	319	135360	217.84	8	42.47	8	117.13	8	69.72	8	36.19	8
	322	215558	45.16	11	11.44	11	5.73	13	34.46	12	99.45	11
	323	95743	91.74	5	29.00	4	49.57	6	105.19	6	353.63	5
	324	67955	108.33	3	19.00	3	9.75	4	92.07	4	2.50	4
	781	61352	97.07	2	3.50	4	2.14	4	15.00	4	7.17	4
	782	25174	-	-	13.00	2	8.50	2	19.00	2	42.61	2
184 - 274	295	28750	-	-	42.11	2	43.67	2	37.11	2	73.10	2
	298	23523	-	-	11.50	2	8.44	2	4.00	2	8.17	2
	300	29851	-	-	1.33	2	5.33	2	6.50	2	3.72	2
	306	49935	5.82	3	5.00	3	3.05	3	6.41	3	6.04	3
	309	40718	6.26	3	2.72	2	9.33	2	1.00	2	7.24	2
	310	23385	8.50	2	7.11	2	22.39	2	6.50	2	8.50	2
	313	22698	15.56	2	4.50	2	31.11	2	5.50	2	9.50	2
	316	25999	34.00	2	67.00	2	41.00	2	1.69	2	0.00	2
	318	17745	36.50	2	49.50	2	45.50	2	9.14	2	11.17	2
	779	58051	62.67	3	10.00	3	8.00	3	32.06	4	9.00	4
	780	55437	-	-	11.56	3	4.67	3	22.70	3	19.56	2
275 - 366	296	9766.8	-	-	5.89	2	31.39	2	30.94	2	49.00	2
	299	29163	-	-	2.39	2	3.51	2	1.50	2	3.56	2
	705	26824	8.71	2	12.00	2	14.28	2	1.44	2	5.50	2
	706	65479	9.33	3	5.89	3	7.25	4	0.67	4	1.75	4
	707	10180	46.80	2	52.89	2	24.00	2	5.33	2	8.00	2
	715	17608	12.78	2	1.14	2	0.00	2	3.00	2	0.44	2
	716	74145	11.76	5	7.89	4	5.39	4	1.94	4	5.21	4
367 - 549	708	17333	59.50	2	626.89	2	23.70	3	0.44	2	3.94	2
	711	81574	3.92	4	0.60	5	0.78	5	0.16	5	0.58	5
	712	100557	2.00	6	3.60	5	1.76	6	1.32	6	2.38	5
	713	117064	2.98	7	4.82	6	3.57	7	2.95	7	5.00	6
	714	147741	3.99	9	3.64	7	4.19	9	4.86	9	2.81	9
550 - 731	709	20221	13.00	2	-	-	7.00	2	0.89	2	3.50	2
732 - 914	710	21460	-	-	-	-	-	-	0.00	2	-	-

Table 5, Cont'd. Mean number per tow and number of sets, by stratum, from Canadian RV surveys in Subdivision 3Ps from 1996 to 2005.

		Year	2002		2003		2004		2005	
Depth range	Stratum	Units	Number	Sets	Number	Sets	Number	Sets	Number	Sets
<=56	314	133984	1.80	8	0.86	7	13.66	8	9.36	8
	320	181581	32.43	10	9.45	11	12.73	11	26.14	11
57 - 91	293	21872	2.00	2	1.5	2	240.57	2	33.14	2
	308	15407	3.00	2	3.5	2	15	2	16.14	2
	312	37417	2.00	2	11.5	2	20.5	2	10.5	2
	315	113763	25.98	7	69.57	7	81.52	7	157.02	7
	321	163560	9.90	10	8.7	10	5.7	10	12.9	10
	325	129858	17.63	8	12.63	8	13.25	8	28.3	8
	326	22835	17.50	2	2.5	2	8	2	6	2
	783	31501	3.50	2	1	2	1	2	26.5	2
93 - 183	294	18571	17.50	2	10	2	23.43	2	72.29	2
	297	20909	16.50	2	12	2	4	2	33.5	2
	307	54337	0.67	3	4	3	20	3	1.81	3
	311	43607	20.33	3	6.33	3	49.33	3	199.56	3
	317	26549	38.50	2	208	2	154	2	413	2
	319	135360	97.13	8	113.25	8	109.48	8	123.25	8
	322	215558	12.46	13	9.76	13	8.97	13	54.92	13
	323	95743	58.00	6	63.97	5	41.89	6	110.86	6
	324	67955	43.75	4	19	4	8.25	4	53.46	4
	781	61352	2.25	4	1.5	4	4.68	4	41.46	4
	782	25174	51.50	2	44	2	107	2	105.5	2
184 - 274	295	28750	36.00	2	33.33	2	110	2	133.5	2
	298	23523	17.72	2	8.5	2	15.5	2	7	2
	300	29851	1.50	2	2.94	2	6.36	2	6.5	2
	306	49935	3.70	3	4.96	3	4	3	4	3
	309	40718	4.00	2	4.89	2	5.52	2	1.71	2
	310	23385	11.89	2	50.5	2	10.5	2	1.33	2
	313	22698	17.50	2	25.5	2	11.94	2	76	2
	316	25999	62.00	2	36.5	2	6.22	2	3	2
	318	17745	92.00	2	694	2	21	2	29	2
	779	58051	18.00	4	14.92	4	4	3	63	4
	780	55437	30.67	3	5.67	3	76.67	3	60.33	3
275 - 366	296	9766.8	67.11	2	52	2	25.21	2	48.57	2
	299	29163	3.00	2	7.28	2	24.5	2	1	2
	705	26824	13.00	2	11.83	2	3.89	2	0.89	2
	706	65479	9.00	4	8.08	4	2.39	4	9.95	4
	707	10180	10.50	2	108	2	10.44	2	15.57	2
	715	17608	9.14	2	10	2	3.11	2	4.44	2
	716	74145	7.86	4	9.14	4	7.75	4	1.72	4
367 - 549	708	17333	3.10	2	4	2	12.61	2	2.89	2
	711	81574	1.60	5	3.18	5	2.2	2	4.53	5
	712	100557	2.83	6	5.74	6	1.72	5	1.33	6
	713	117064	4.96	7	6.21	7	3.96	6	4.95	7
	714	147741	3.36	9	6.96	9	5.67	7	1.43	9
550 - 731	709	20221	8.80	2	6.78	2	7.11	2	1.71	2
732 - 914	710	21460	-	-	-	-	-	-	-	-

Table 6. Mean weight per tow and number of sets, by stratum, from Canadian RV surveys in Subdivision 3Ps from 1996 to 2005.

		Year	1996		1997		1998		1999		2000	
Depth range	Stratum	Units	Weight	Sets	Weight	Sets	Weight	Sets	Weight	Sets	Weight	Sets
<=56	314	133984	0.58	8	0.14	7	2.87	7	7.89	8	5.10	7
	320	181581	4.13	10	0.45	9	7.31	11	10.90	8	14.53	11
57 - 91	293	21872	-	-	0.01	2	0.08	2	0.67	2	0.05	2
	308	15407	0.80	2	0.19	2	0.14	2	12.35	2	7.87	2
	312	37417	1.62	3	0.03	2	1.64	2	6.40	2	2.25	2
	315	113763	15.03	6	1.55	6	13.85	7	9.74	7	31.99	7
	321	163560	2.27	9	1.33	9	1.45	10	7.88	9	17.05	10
	325	129858	1.89	9	2.80	6	3.50	8	5.79	8	10.45	8
	326	22835	2.53	2	0.55	2	2.15	2	2.16	2	6.38	2
	783	31501	-	-	0.00	2	0.04	2	0.23	2	0.20	2
93 - 183	294	18571	-	-	0.04	2	1.35	2	0.98	2	4.04	2
	297	20909	-	-	1.25	2	1.59	2	2.46	2	4.01	2
	307	54337	0.24	4	0.00	3	1.82	3	3.30	3	1.40	3
	311	43607	1.85	3	11.98	2	13.72	3	13.37	3	33.63	3
	317	26549	26.10	2	2.38	2	35.28	2	14.20	2	43.55	2
	319	135360	26.90	8	4.89	8	35.15	8	15.85	8	7.00	8
	322	215558	2.76	11	0.82	11	0.38	13	5.62	12	9.34	11
	323	95743	6.80	5	1.40	4	4.99	6	13.13	6	25.40	5
	324	67955	5.87	3	1.17	3	0.58	4	11.22	4	0.18	4
	781	61352	4.23	2	0.21	4	0.14	4	1.14	4	0.23	4
	782	25174	-	-	0.75	2	0.51	2	1.50	2	2.38	2
184 - 274	295	28750	-	-	5.13	2	5.46	2	6.64	2	13.12	2
	298	23523	-	-	2.33	2	3.44	2	0.93	2	1.37	2
	300	29851	-	-	0.40	2	1.63	2	0.60	2	0.16	2
	306	49935	0.76	3	0.63	3	0.29	3	1.52	3	0.65	3
	309	40718	1.43	3	0.66	2	1.89	2	0.06	2	2.23	2
	310	23385	2.50	2	3.26	2	10.22	2	2.95	2	3.84	2
	313	22698	3.91	2	2.18	2	12.69	2	1.60	2	2.33	2
	316	25999	12.75	2	38.68	2	28.80	2	0.70	2	0.00	2
	318	17745	10.13	2	12.62	2	15.78	2	2.43	2	2.58	2
	779	58051	6.15	3	1.15	3	1.05	3	3.97	4	0.55	4
	780	55437	-	-	0.72	3	0.43	3	2.58	3	2.00	2
275 - 366	296	9766.8	-	-	1.73	2	10.55	2	8.29	2	18.63	2
	299	29163	-	-	0.62	2	0.87	2	1.75	2	1.73	2
	705	26824	5.22	2	5.35	2	5.31	2	0.27	2	1.88	2
	706	65479	3.10	3	2.35	3	4.06	4	0.24	4	0.76	4
	707	10180	11.48	2	14.91	2	11.51	2	2.00	2	5.05	2
	715	17608	7.81	2	0.32	2	0.00	2	1.04	2	0.01	2
	716	74145	3.89	5	3.06	4	2.46	4	0.83	4	1.84	4
367 - 549	708	17333	22.15	2	189.67	2	6.59	3	0.38	2	1.79	2
	711	81574	0.83	4	0.04	5	0.06	5	0.01	5	0.26	5
	712	100557	0.50	6	0.79	5	0.17	6	0.35	6	0.47	5
	713	117064	0.76	7	1.08	6	0.39	7	0.32	7	0.69	6
	714	147741	0.58	9	0.90	7	0.69	9	0.50	9	0.30	9
550 - 731	709	20221	4.03	2	-	-	1.58	2	0.29	2	2.25	2
732 - 914	710	21460	-	-	-	-	-	-	0.00	2	-	-

Table 6, Cont'd. Mean weight per tow and number of sets, by stratum, from Canadian RV surveys in Subdivision 3Ps from 1996 to 2005.

		Year	2001		2002		2003		2004		2005	
Depth range	Stratum	Units	Weight	Sets	Weight	Sets	Weight	Sets	Weight	Sets	Weight	Sets
<=56	314	133984	1.56	7	1.55	8	0.41	7	7.38	8	6.92	8
	320	181581	8.91	10	26.77	10	7.76	11	9.45	11	23.85	11
57 - 91	293	21872	0.00	2	0.11	2	0.01	2	9.05	2	8.06	2
	308	15407	3.70	2	2.17	2	0.41	2	10.25	2	11.52	2
	312	37417	2.17	2	0.98	2	1.2	2	4.43	2	6.65	2
	315	113763	18.42	7	9.98	7	19.51	7	28.97	7	43.42	7
	321	163560	1.56	9	1.14	10	2.6	10	2.13	10	6.79	10
	325	129858	9.16	8	2.83	8	1.33	8	2.34	8	4.19	8
	326	22835	11.68	2	2.45	2	0.21	2	0.59	2	1.02	2
	783	31501	1.42	2	0.55	2	0.01	2	0.08	2	2.7	2
93 - 183	294	18571	1.73	2	0.96	2	1.7	2	2.86	2	19.72	2
	297	20909	0.48	2	1.60	2	0.75	2	0.43	2	3.47	2
	307	54337	1.28	3	0.10	3	3.8	3	9.17	3	0.39	3
	311	43607	3.30	3	8.98	3	1	3	5.63	3	19.98	3
	317	26549	124.30	2	4.50	2	36.6	2	34.75	2	37.37	2
	319	135360	33.44	8	24.73	8	18.99	8	14.65	8	19.84	8
	322	215558	2.27	12	0.63	13	0.95	13	0.62	13	8.19	13
	323	95743	8.76	6	3.25	6	3.42	5	2.49	6	11.69	6
	324	67955	0.19	4	1.90	4	0.69	4	0.34	4	6.06	4
	781	61352	1.03	4	0.14	4	0.06	4	0.16	4	3.5	4
	782	25174	0.45	2	2.50	2	2.28	2	9.84	2	12.37	2
184 - 274	295	28750	2.27	2	3.47	2	6.38	2	9.97	2	18	2
	298	23523	2.05	2	4.70	2	1.47	2	2.1	2	1.2	2
	300	29851	0.31	2	0.08	2	0.27	2	1.33	2	0.89	2
	306	49935	0.55	3	0.88	3	1.29	3	0.82	3	0.54	3
	309	40718	2.68	2	1.19	2	0.39	2	1.59	2	0.68	2
	310	23385	18.03	2	3.10	2	12.68	2	2.55	2	0.4	2
	313	22698	13.59	2	9.08	2	11.1	2	4.06	2	8.01	2
	316	25999	3.70	2	43.23	2	26.18	2	4.76	2	1.58	2
	318	17745	25.88	2	50.60	2	251.73	2	8.78	2	14.05	2
	779	58051	1.75	4	0.89	4	1.3	4	0.22	3	8.76	4
	780	55437	1.67	3	2.25	3	0.69	3	10.42	3	9.9	3
275 - 366	296	9766.8	23.93	2	27.51	2	13.63	2	10.3	2	9.25	2
	299	29163	1.66	2	0.14	2	1.88	2	7.31	2	0.08	2
	705	26824	0.93	2	8.52	2	6.16	2	0.79	2	0.96	2
	706	65479	0.01	4	4.90	4	5.23	4	0.37	4	2.72	4
	707	10180	6.29	2	4.97	2	66.15	2	2.58	2	6.51	2
	715	17608	0.46	2	2.69	2	3.03	2	0.89	2	0.78	2
	716	74145	3.54	4	4.30	4	5.08	4	2.8	4	0.38	4
367 - 549	708	17333	13.43	2	1.24	2	2.04	2	5.26	2	1.49	2
	711	81574	1.98	5	0.46	5	0.72	5	0.92	5	1.81	5
	712	100557	0.22	6	0.25	6	0.86	6	0.52	6	0.17	6
	713	117064	0.48	6	0.66	7	0.73	7	0.39	7	0.27	7
	714	147741	0.45	9	0.95	9	1.34	9	0.36	9	0.08	9
550 - 731	709	20221	2.60	2	3.47	2	1.79	2	3	2	1	2
732 - 914	710	21460	-	-	-	-	-	-	-	-	-	-

Table 7. Abundance (millions) index at age for American plaice in Subdivision 3Ps from Canadian research vessel surveys from 1983 to 2005. Data from 1983 to 1995 are Campelen equivalents.

age/year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993 Apr	1994
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.12	0.27	0.00	0.00	0.00	0.00	0.00	0.11	0.71	0.14	0.00	0.23
3	2.84	0.00	0.48	1.02	2.14	1.21	1.98	0.36	2.82	0.40	0.00	0.19
4	22.02	3.36	7.59	11.80	6.23	7.60	8.59	3.71	5.75	1.02	0.06	3.23
5	101.96	31.20	40.16	34.27	32.45	32.44	18.77	11.97	22.55	8.26	3.07	7.38
6	142.59	78.99	81.77	90.21	67.65	61.67	39.89	10.37	40.00	14.96	12.07	9.99
7	112.32	46.34	73.58	84.66	75.07	42.40	39.95	9.31	33.97	14.12	11.35	9.02
8	63.09	21.66	26.51	32.29	50.28	35.73	14.56	6.17	26.62	4.88	6.86	6.73
9	35.25	13.19	21.71	12.94	21.92	15.24	9.82	3.84	11.37	3.42	3.28	3.42
10	15.57	10.09	17.57	8.73	13.24	8.57	4.73	2.42	6.45	2.38	1.99	1.79
11	9.71	5.45	10.35	4.96	5.83	3.57	3.00	1.37	2.57	1.36	0.95	0.91
12	4.98	3.06	7.12	4.13	5.12	2.50	2.74	0.84	2.05	0.93	0.67	0.29
13	3.19	1.27	6.97	3.06	3.24	1.37	1.88	0.35	1.35	0.94	0.48	0.12
14	1.95	0.91	4.79	1.64	2.04	1.09	1.08	0.39	0.69	0.43	0.26	0.03
15	1.23	0.62	4.64	1.72	1.83	0.98	0.69	0.39	0.86	0.72	0.21	0.00
16	1.29	0.28	3.91	1.14	1.22	0.58	0.85	0.30	0.73	0.33	0.16	0.00
17	0.41	0.20	2.12	0.42	0.40	0.45	0.35	0.19	0.21	0.15	0.07	0.00
18	0.25	0.14	2.34	0.33	0.27	0.05	0.23	0.15	0.05	0.07	0.03	0.00
19	0.19	0.02	0.14	0.06	0.05	0.03	0.09	0.05	0.01	0.00	0.01	0.00
20	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.00
UNKNOWN	0.00	0.27	1.04	0.00	0.00	0.00	0.02	0.00	0.18	0.11	0.00	0.01
TOTAL	518.96	217.33	312.85	293.38	288.98	215.50	149.23	52.30	158.98	54.64	41.54	43.34

Table 7 Cont'd. Abundance (millions) index at age for American plaice in Subdivision 3Ps from Canadian research vessel surveys from 1983 to 2005. Data from 1983 to 1995 are Campelen equivalents.

age/year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.03	0.02	0.35	1.41	0.05	0.03	0.03	0.07	0.15
2	0.00	4.67	0.37	0.60	2.17	34.60	5.95	1.54	1.86	0.69	17.42
3	0.00	11.94	7.22	0.62	3.02	20.66	24.40	9.12	4.42	6.57	8.27
4	0.47	20.54	8.73	6.19	4.65	11.93	9.43	15.38	15.68	9.44	12.35
5	4.95	24.91	7.96	8.78	16.04	11.71	4.46	4.38	18.52	23.84	27.20
6	11.72	11.54	7.37	6.12	14.80	17.52	6.93	2.65	7.57	12.37	27.59
7	14.94	10.90	7.36	10.31	9.86	12.79	7.21	3.86	4.08	4.99	10.63
8	8.67	3.92	3.62	7.16	6.59	8.90	7.07	4.92	4.94	3.11	3.86
9	5.24	2.14	1.62	6.27	4.56	7.05	6.05	4.18	4.82	2.96	3.05
10	2.04	0.80	0.53	2.88	3.21	3.94	3.78	2.70	3.09	1.34	2.32
11	0.97	0.32	0.24	1.69	1.99	3.18	2.74	2.28	1.42	1.14	2.16
12	0.36	0.17	0.20	0.97	1.11	1.60	1.84	1.76	1.34	0.71	1.14
13	0.18	0.02	0.09	0.56	0.43	1.02	0.98	0.92	0.83	0.29	0.36
14	0.10	0.02	0.10	0.15	0.25	0.53	0.47	0.53	0.61	0.28	0.48
15	0.01	0.03	0.01	0.15	0.09	0.17	0.42	0.18	0.40	0.21	0.23
16	0.00	0.00	0.00	0.10	0.02	0.05	0.10	0.12	0.28	0.12	0.59
17	0.00	0.00	0.00	0.06	0.00	0.14	0.09	0.07	0.13	0.12	0.38
18	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.07	0.04	0.02
19	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
UNKNOWN	0.13	0.15	0.01	0.00	0.04	0.09	0.06	0.15	0.00	0.05	0.31
TOTAL	49.77	92.09	45.46	52.62	69.18	137.28	82.06	54.84	70.13	68.35	118.50

Table 8. Average estimates of total mortality for ages 2 to 17 for 5 year periods from research vessel surveys in Subdivision 3Ps.

Years/age	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1983-1987	0.58	1.61	1.40	0.57	-0.36	-0.86	-0.77	-0.56	-0.80	-0.52	-0.59	-0.57	-0.23	-0.51	-0.82	-0.60
1988-1992	1.34	0.49	0.90	0.16	-0.40	-0.91	-0.89	-0.83	-0.94	-0.57	-0.66	-0.71	-0.27	-0.56	-1.10	-1.11
1993-1997	0.48	0.15	1.65	0.20	-0.02	-0.61	-0.54	-0.76	-0.66	-0.59	-0.94	-0.61	-0.65	2.30		
1998-2005	1.25	0.58	0.26	-0.02	-0.18	-0.26	-0.26	-0.58	-0.34	-0.41	-0.72	-0.43	-0.52	-0.59	0.43	-1.06

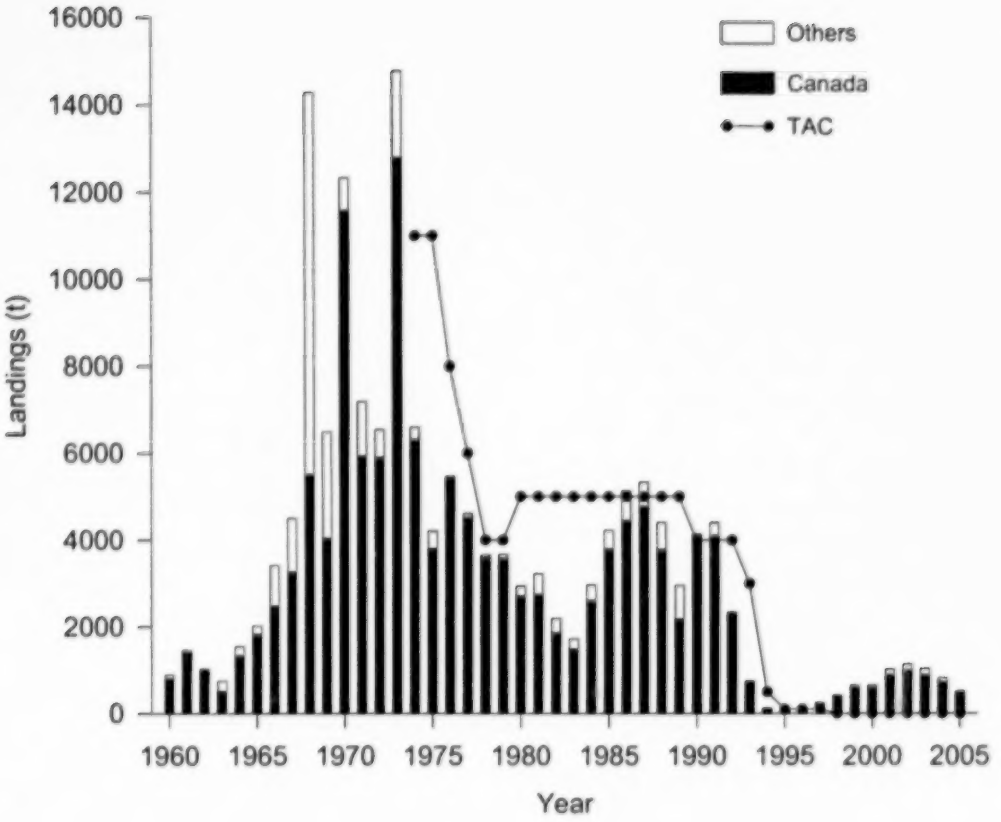


Figure 1. Total landings by Canada (black bars) and other countries (white bars) as well as total allowable catch (TAC) for each year from 1960 to 2005. Catch data for 2005 are incomplete.

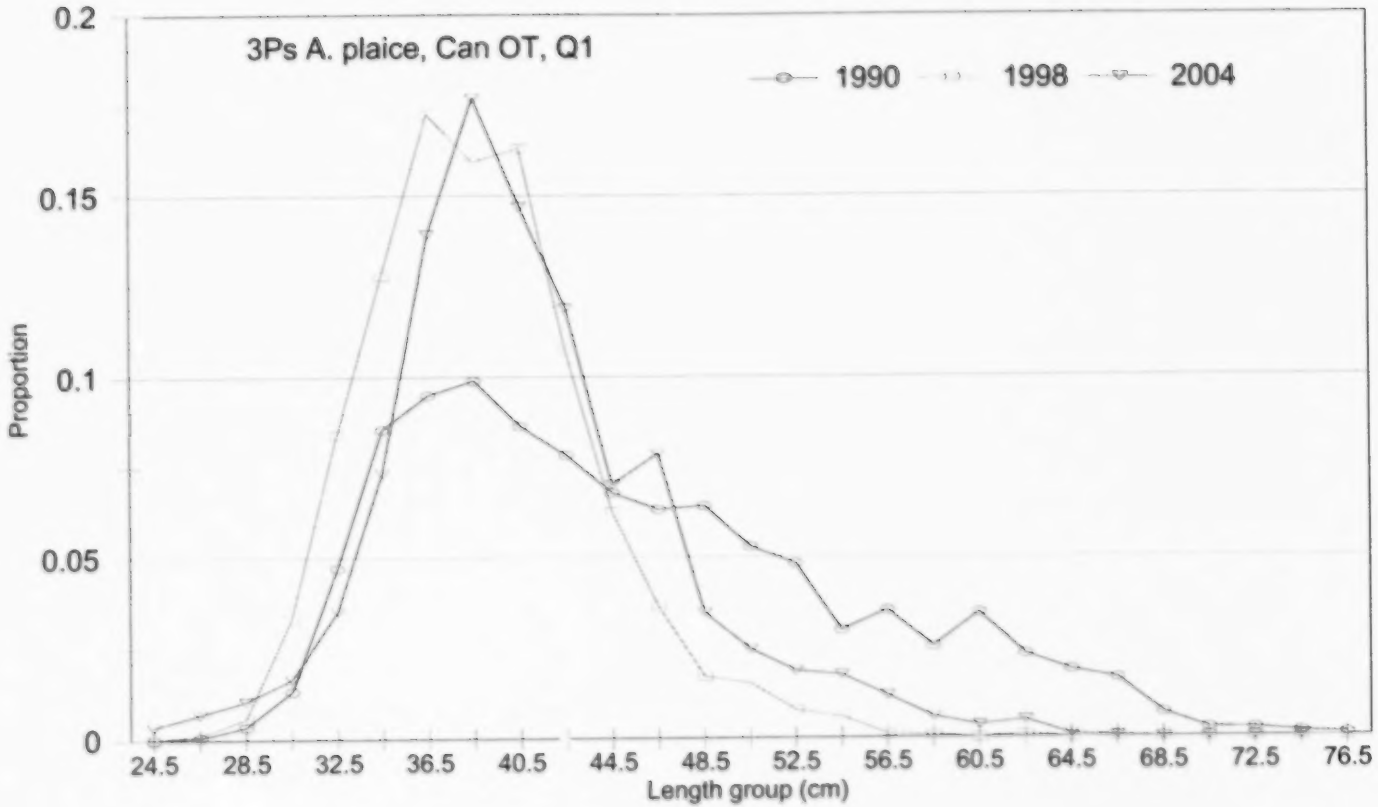


Figure 2. Comparison of length frequencies from Canadian otter trawl fisheries, first quarter catches, in 1990, 1998, and 2004.

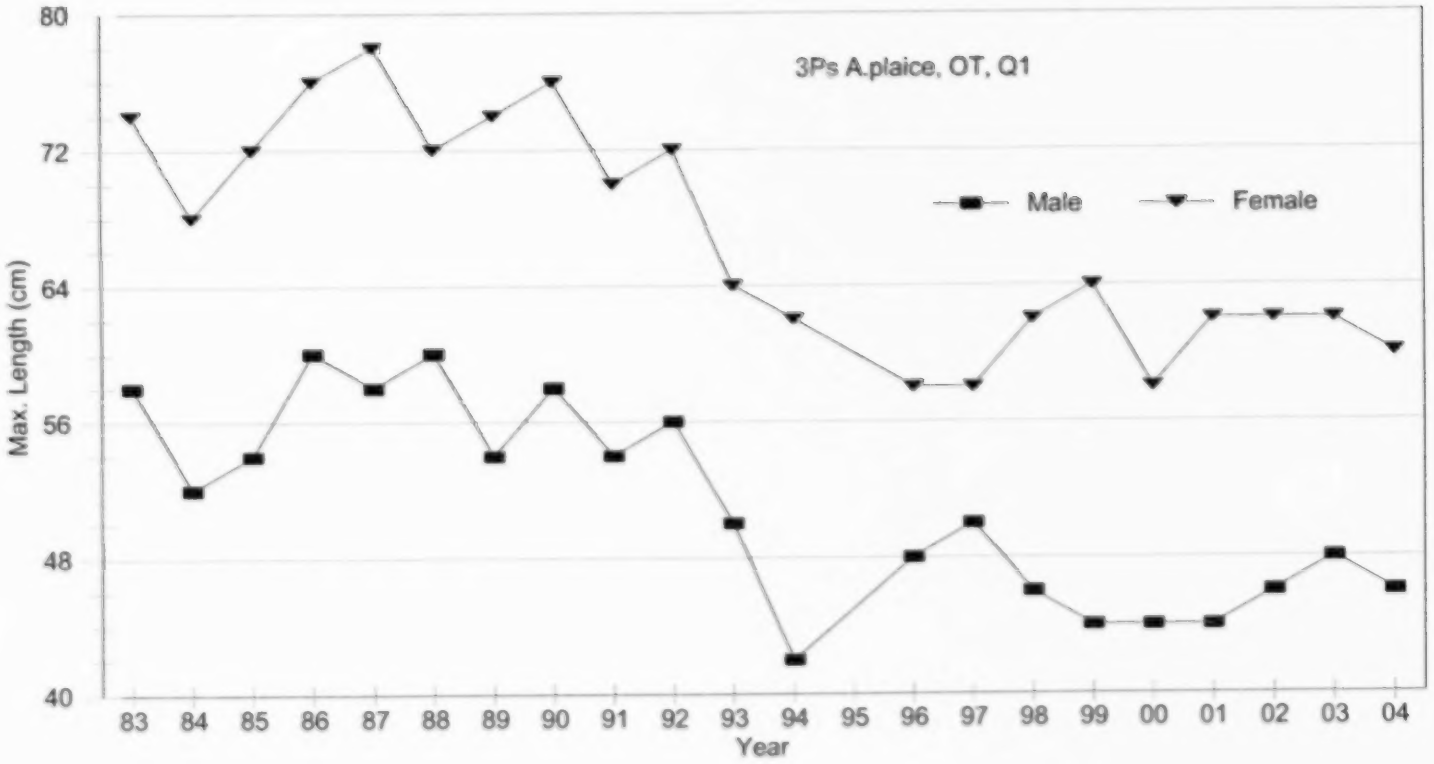


Figure 3. Maximum size of American plaice in length frequencies from Canadian otter trawl fisheries, Subdiv. 3Ps, 1983-2004.

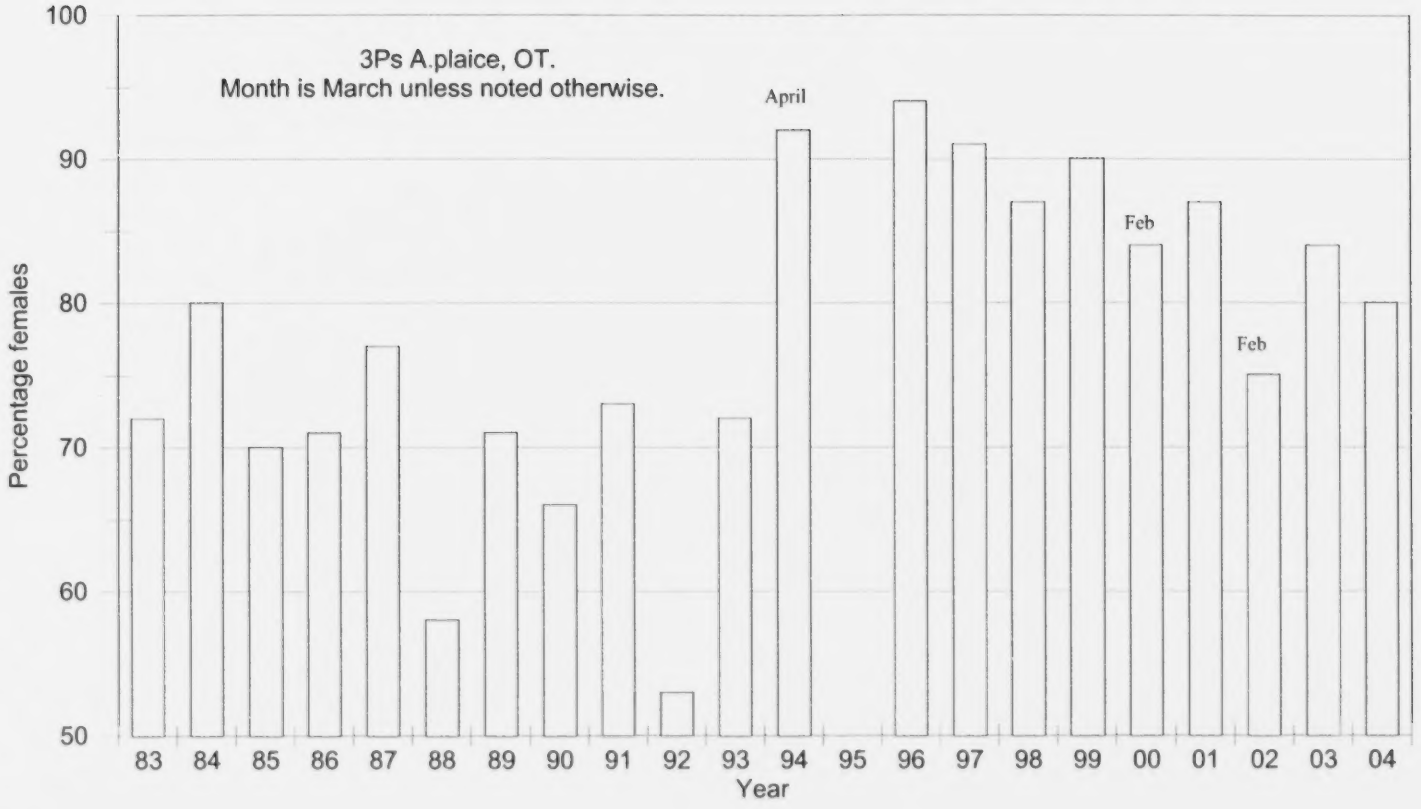


Figure 4. Percentage of female American plaice in length frequencies from Canadian OT fishery, Subdiv 3Ps, 1983-2004

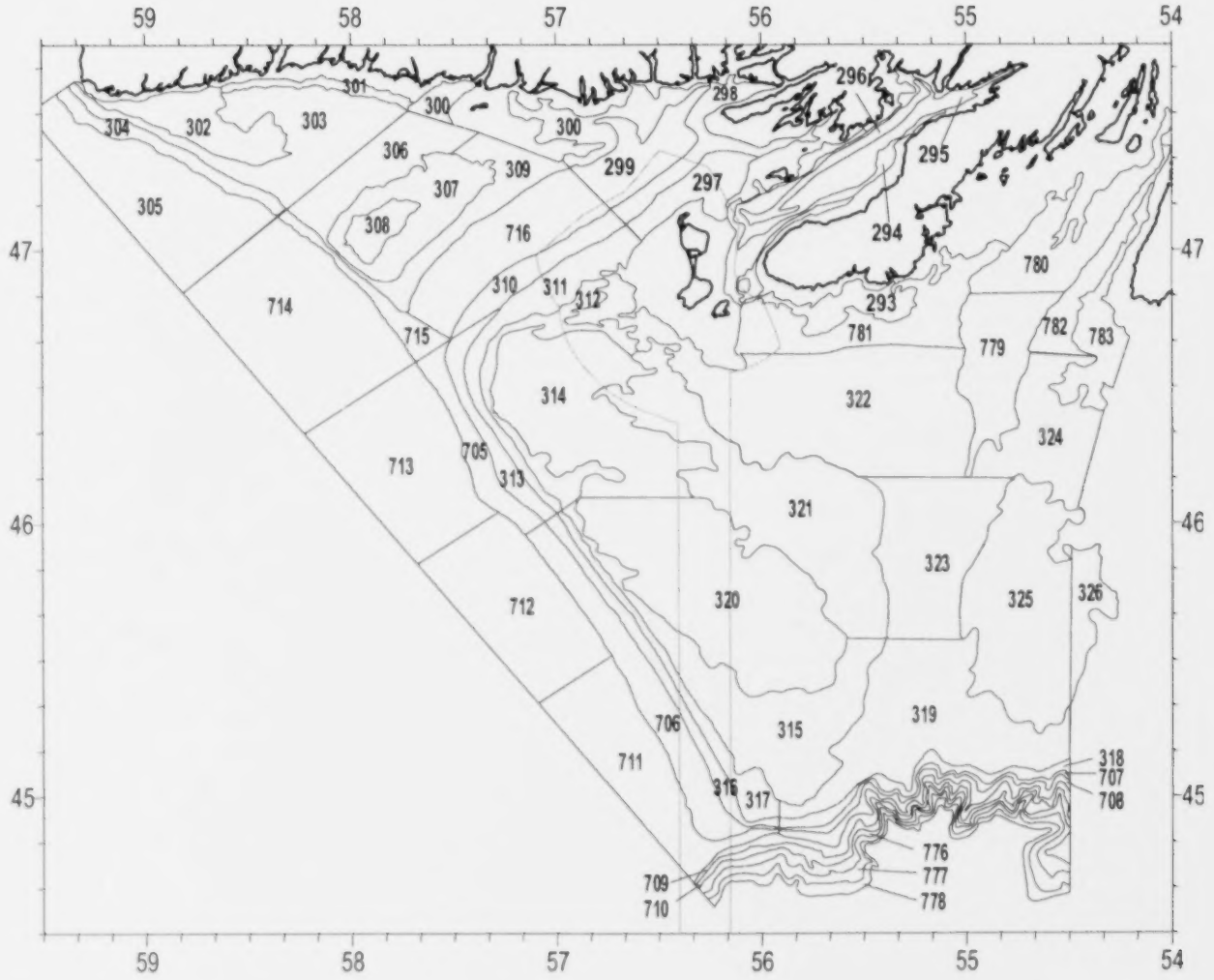
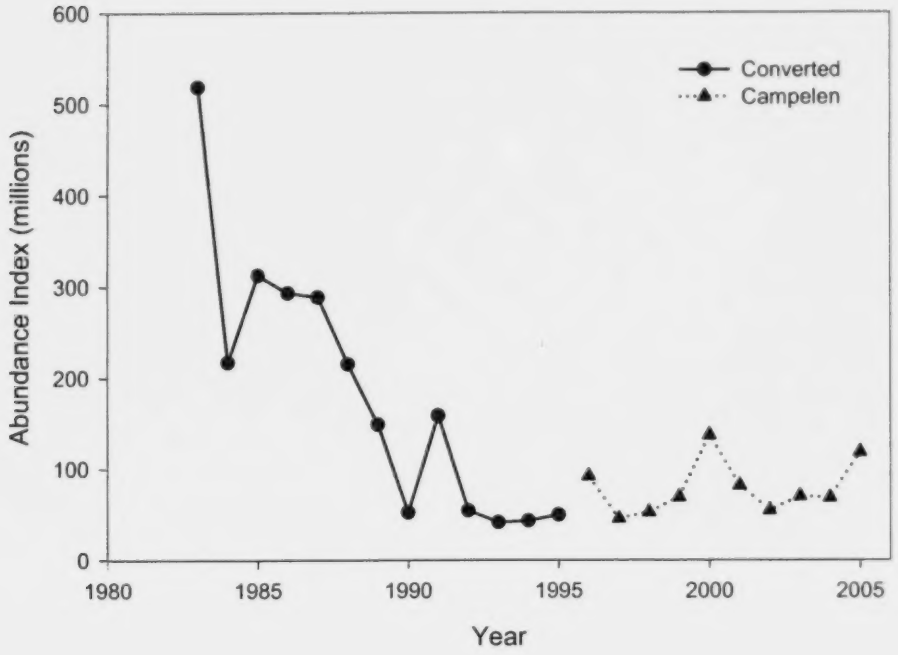


Figure 5. Stratification scheme used in research vessel surveys of NAFO Subdivision 3Ps.



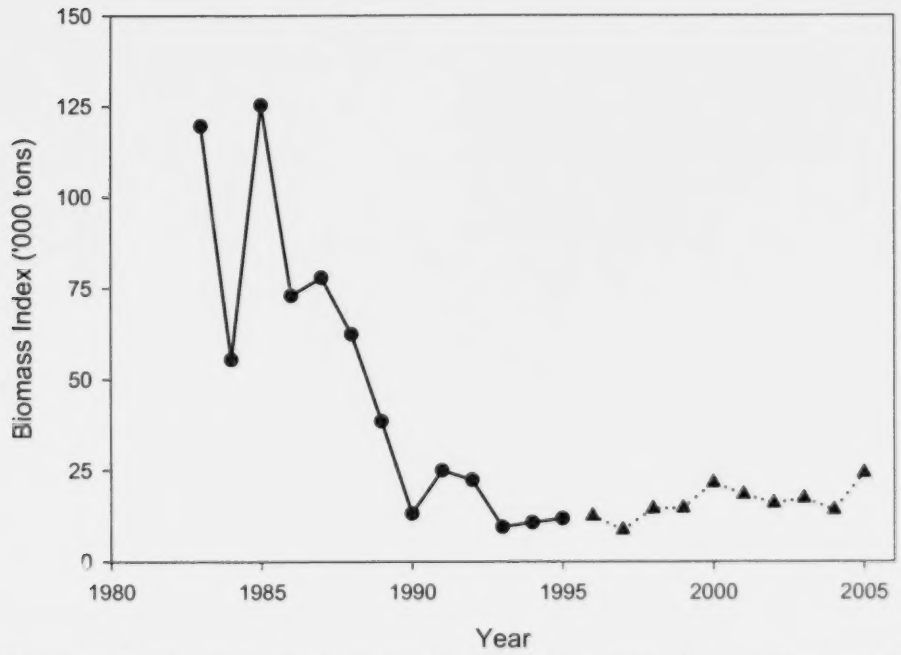


Figure 6. Abundance and biomass indices from research vessel surveys from 1983 to 2005. Converted (1983-1995) and Campelen (1996-2005) data are shown. The 1993 data are from the April survey.

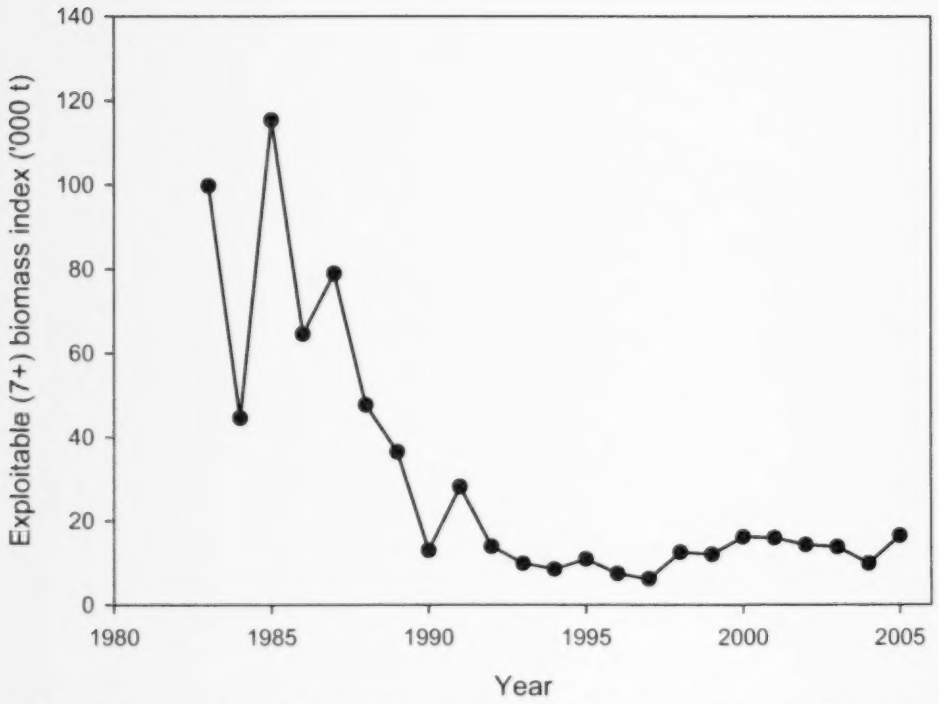


Figure 7. Exploitable (age 7+) biomass index from research vessel surveys from 1983 to 2005. Converted (1983-1995) and Campelen (1996-2005) data are shown. The 1993 data are from the April survey.

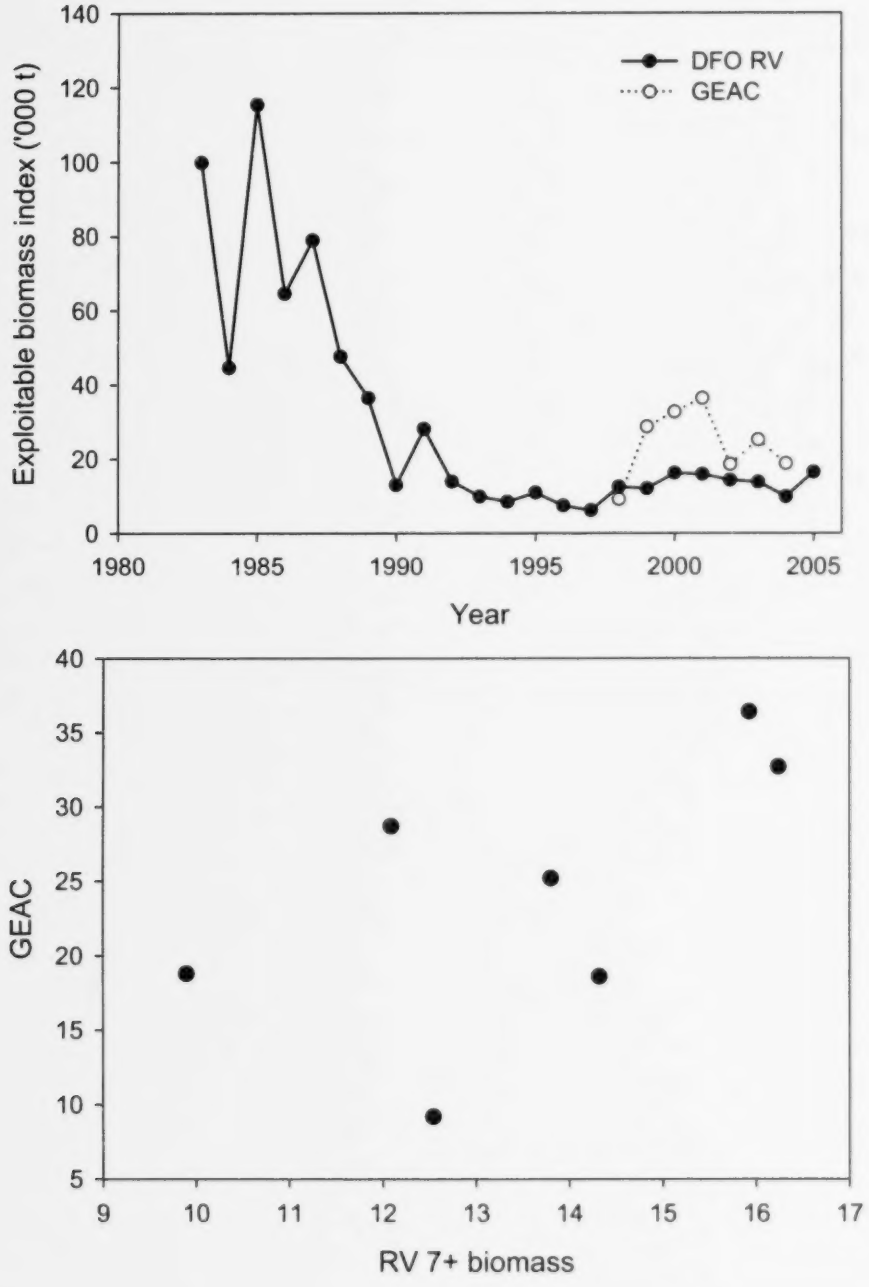


Figure 8. Exploitable (age 7+) biomass index from research vessel surveys from 1983 to 2005 as well as biomass from industry (GEAC) survey from 1998 to 2004 (top). Comparison of the two surveys from 1998 to 2004 (bottom).

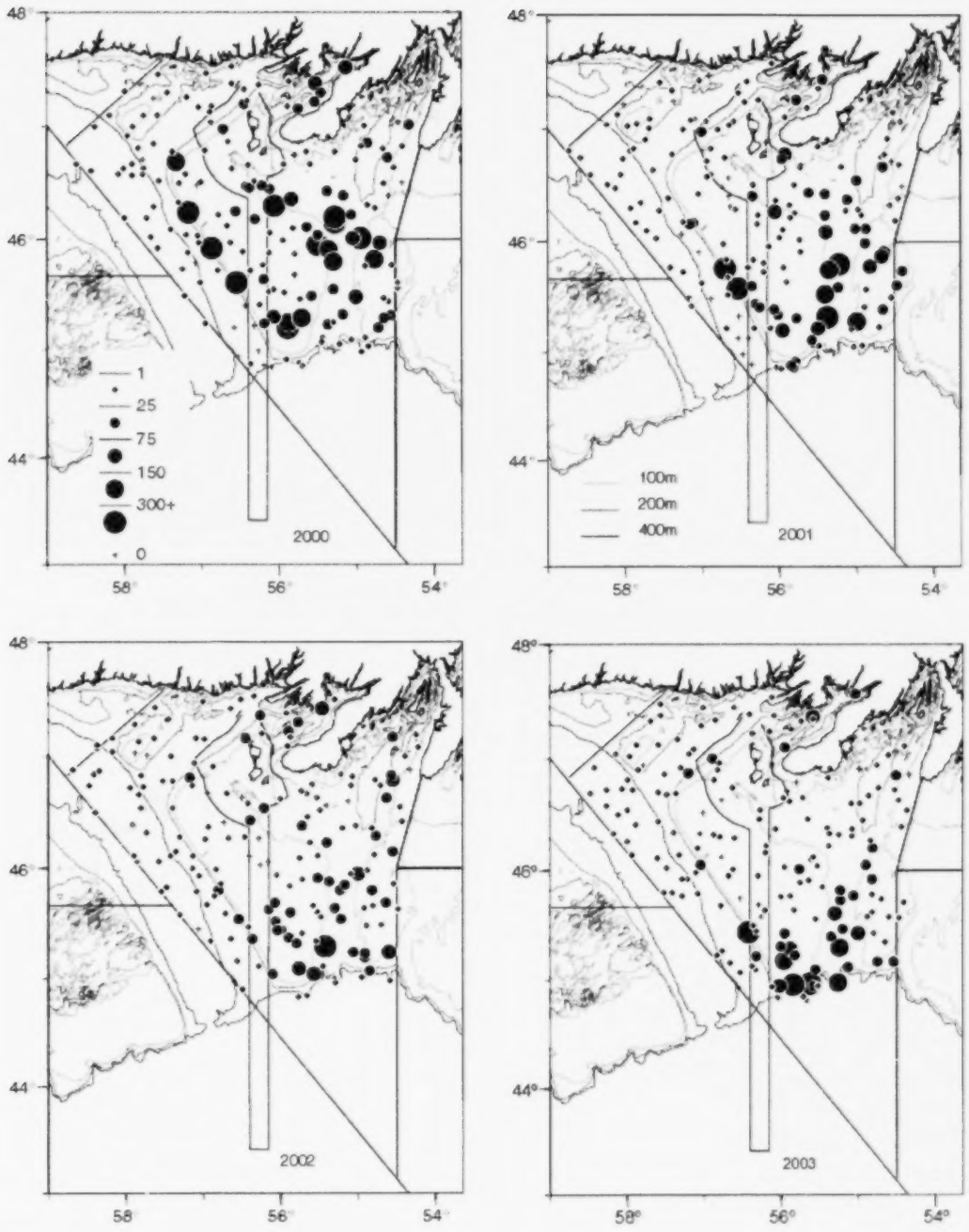


Figure 9. Distribution of American plaice (number) from research vessel surveys in NAFO Subdivision 3Ps from 2000-2005.

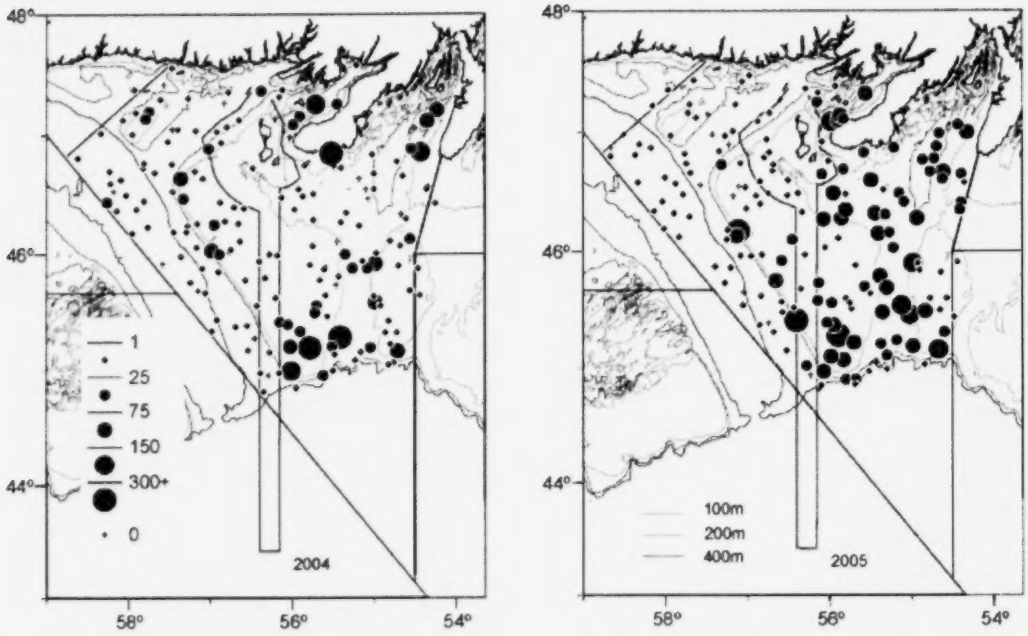


Figure 9 Cont'd

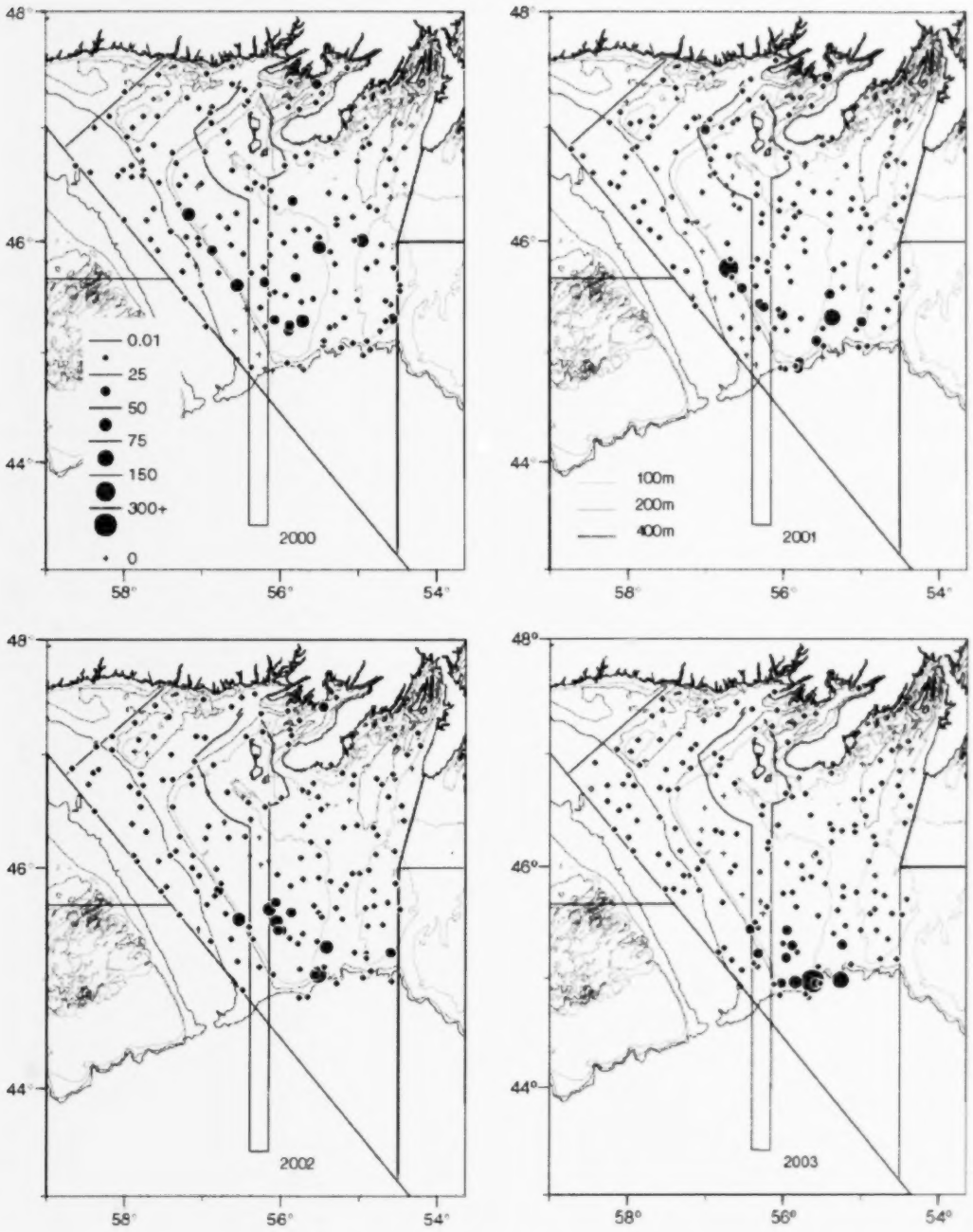


Figure 10. Distribution of American plaice (Kg) from research vessel surveys in NAFO Subdivision 3Ps from 2000-2005.

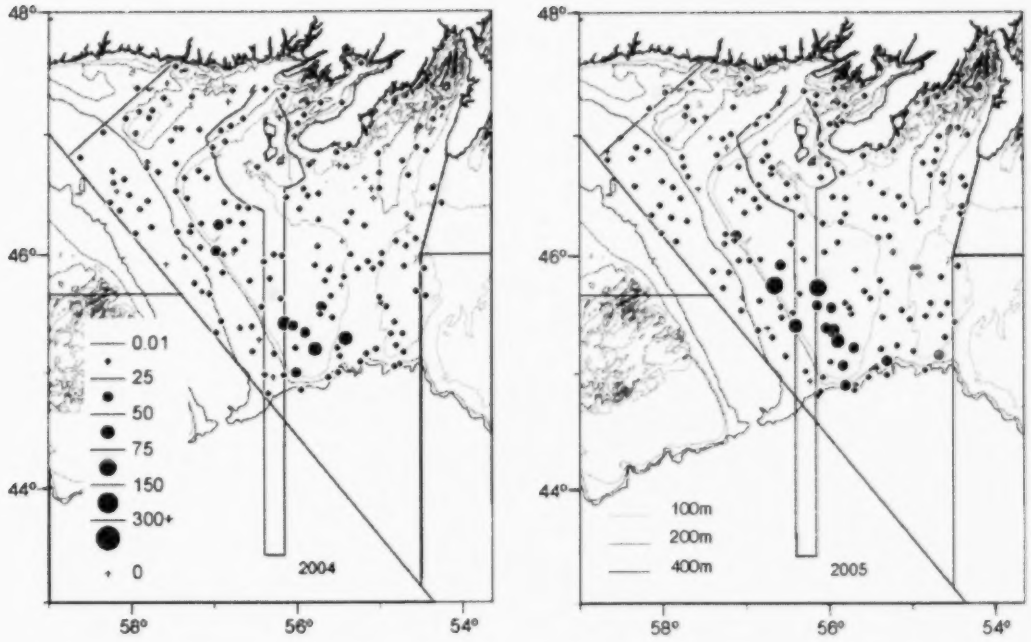


Figure 10 Cont'd

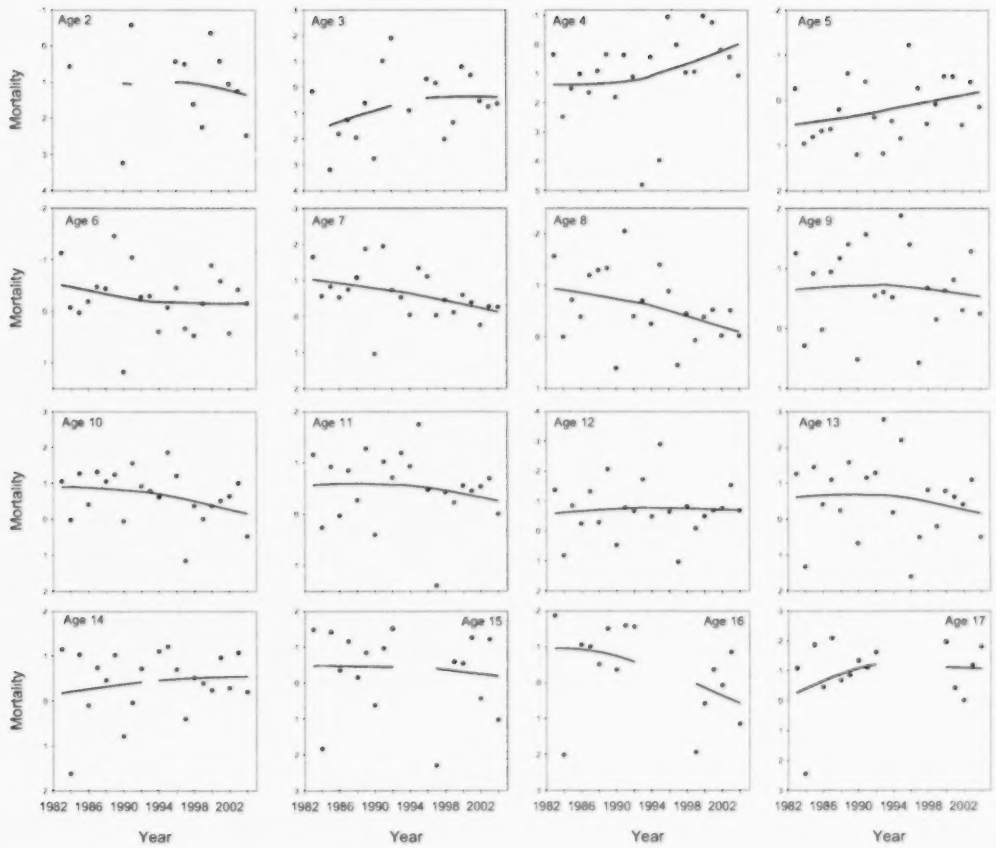


Figure 11. Estimates of mortality for ages 2 to 17 of American plaice from research vessel surveys in Subdivision 3Ps from 1983 to 2005.

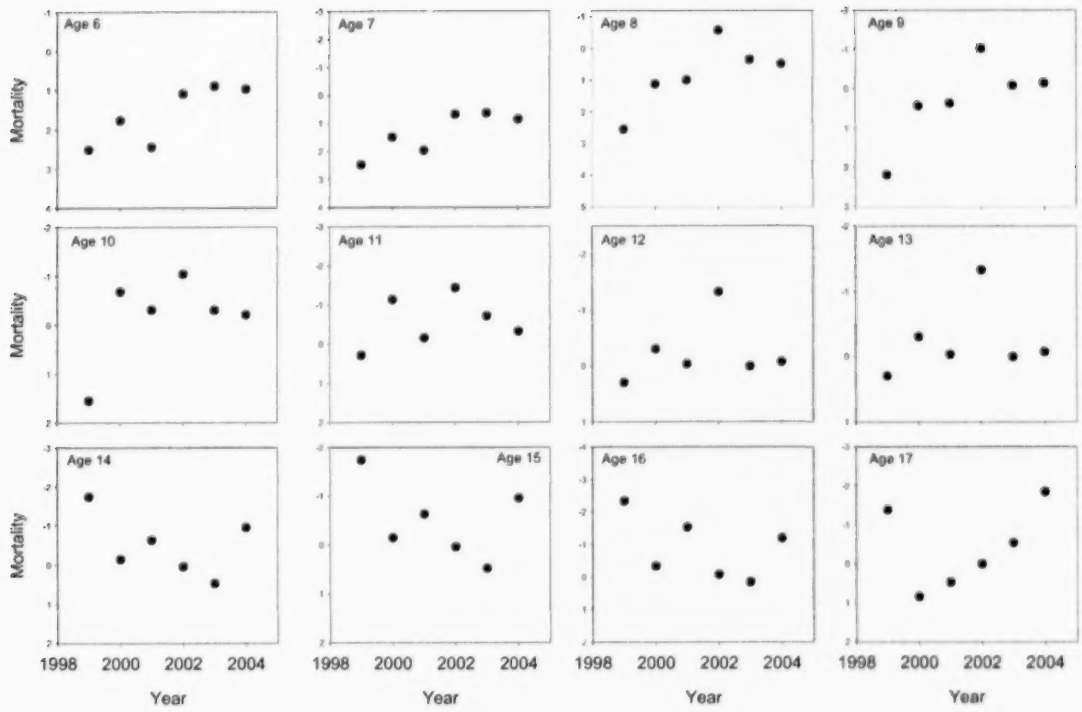


Figure 12. Estimates of mortality for ages 6 to 17 of American plaice from industry (GEAC) surveys in Subdivision 3Ps from 1998 to 2004.

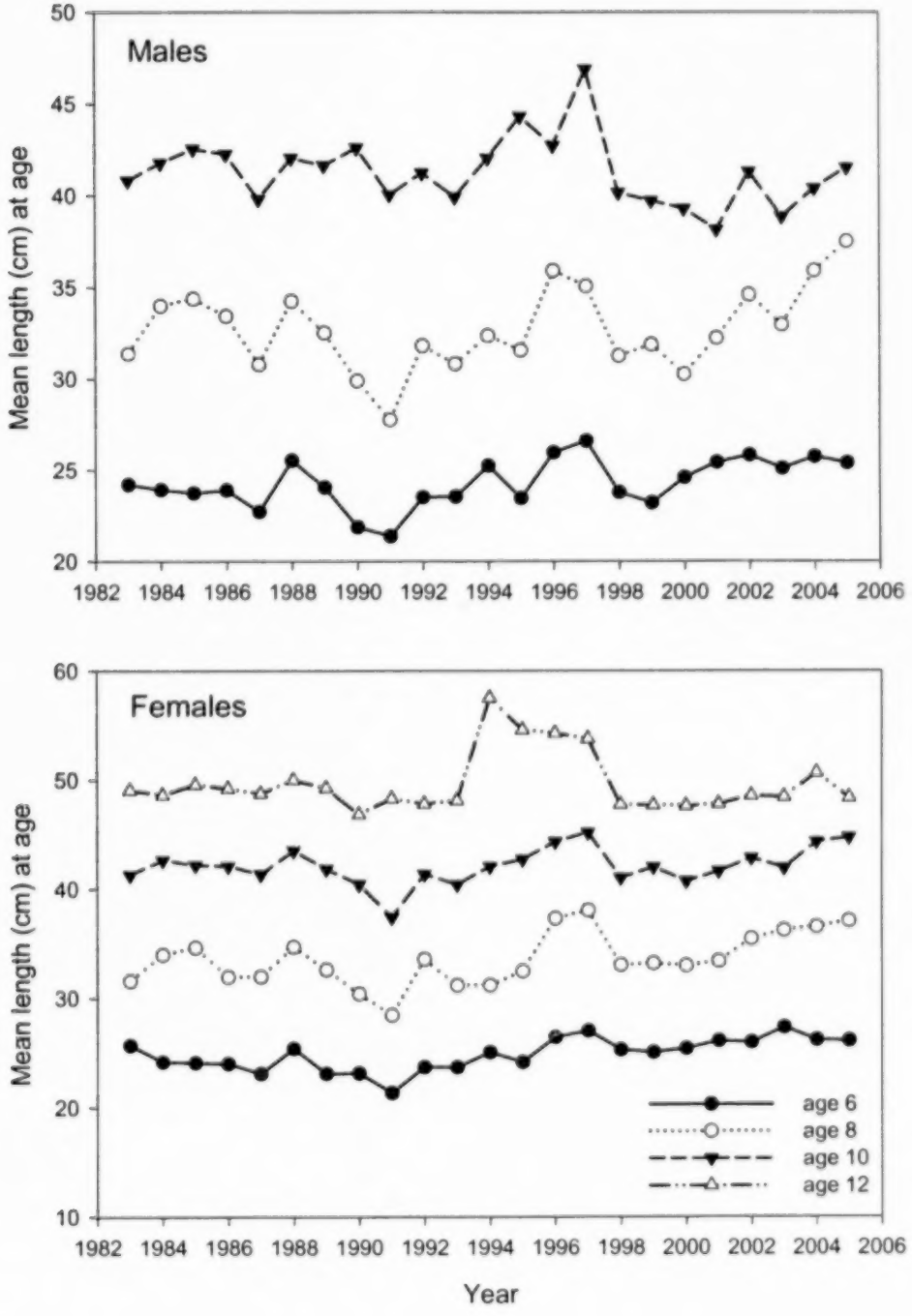


Figure 13. Mean length at age for selected ages of male and female American plaice from research vessel surveys in Subdivision 3Ps from 1983 to 2005.

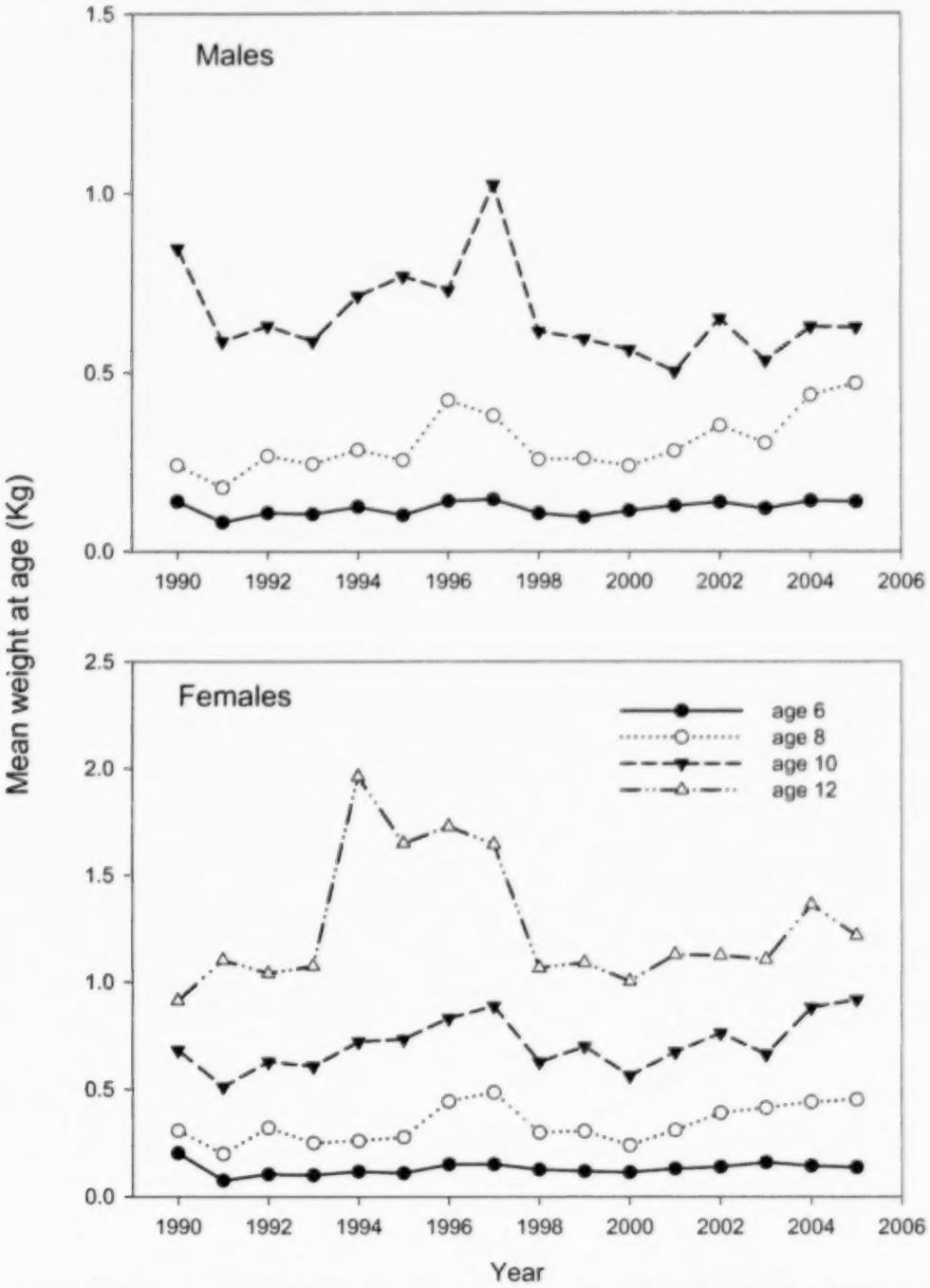


Figure 14. Mean weight at age for selected ages of male and female American plaice from research vessel surveys in Subdivision 3Ps from 1990 to 2005.

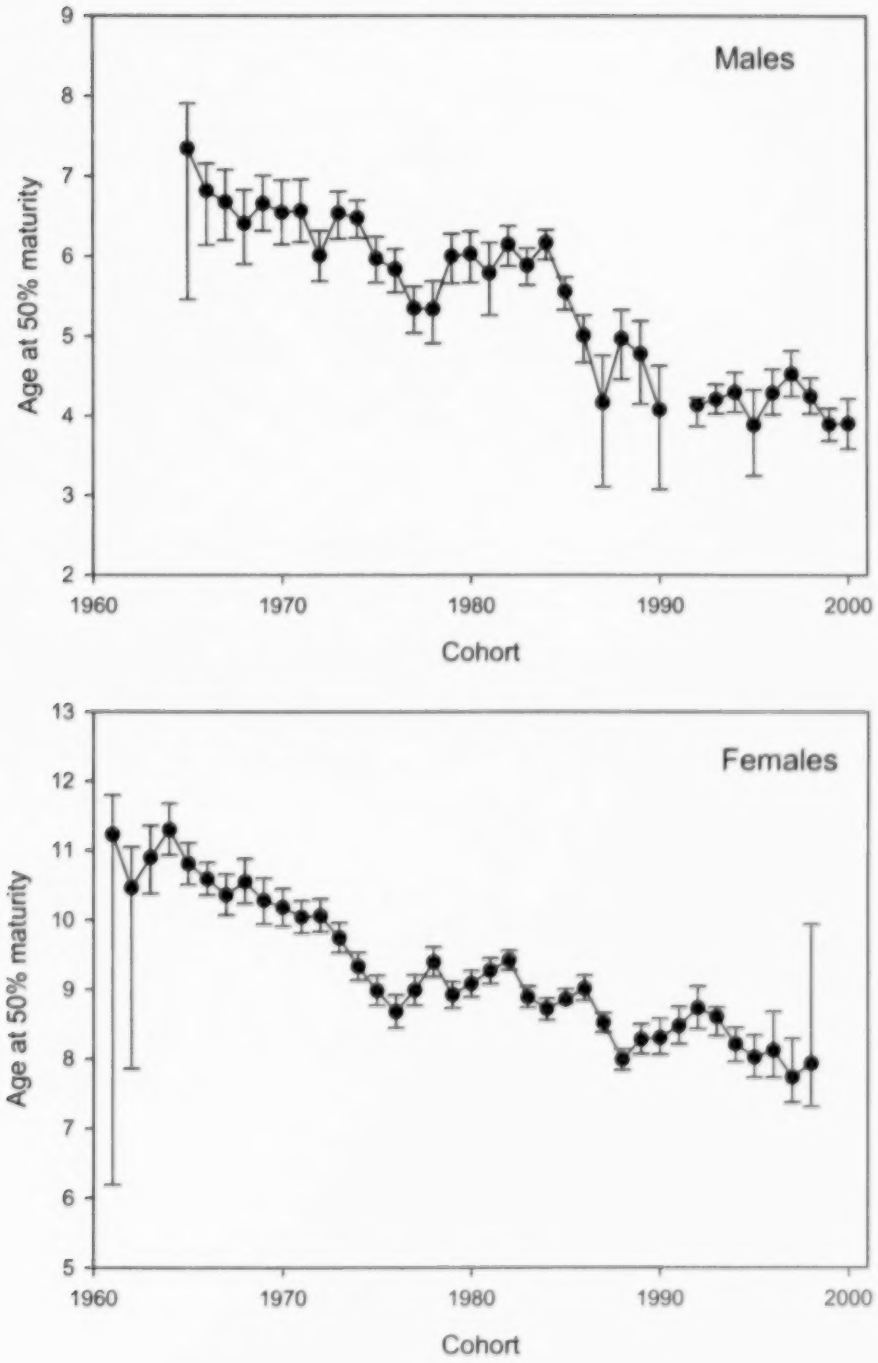


Figure 15. Age at 50% maturity by cohort for male and female American plaice from research vessel surveys in Subdivision 3Ps.

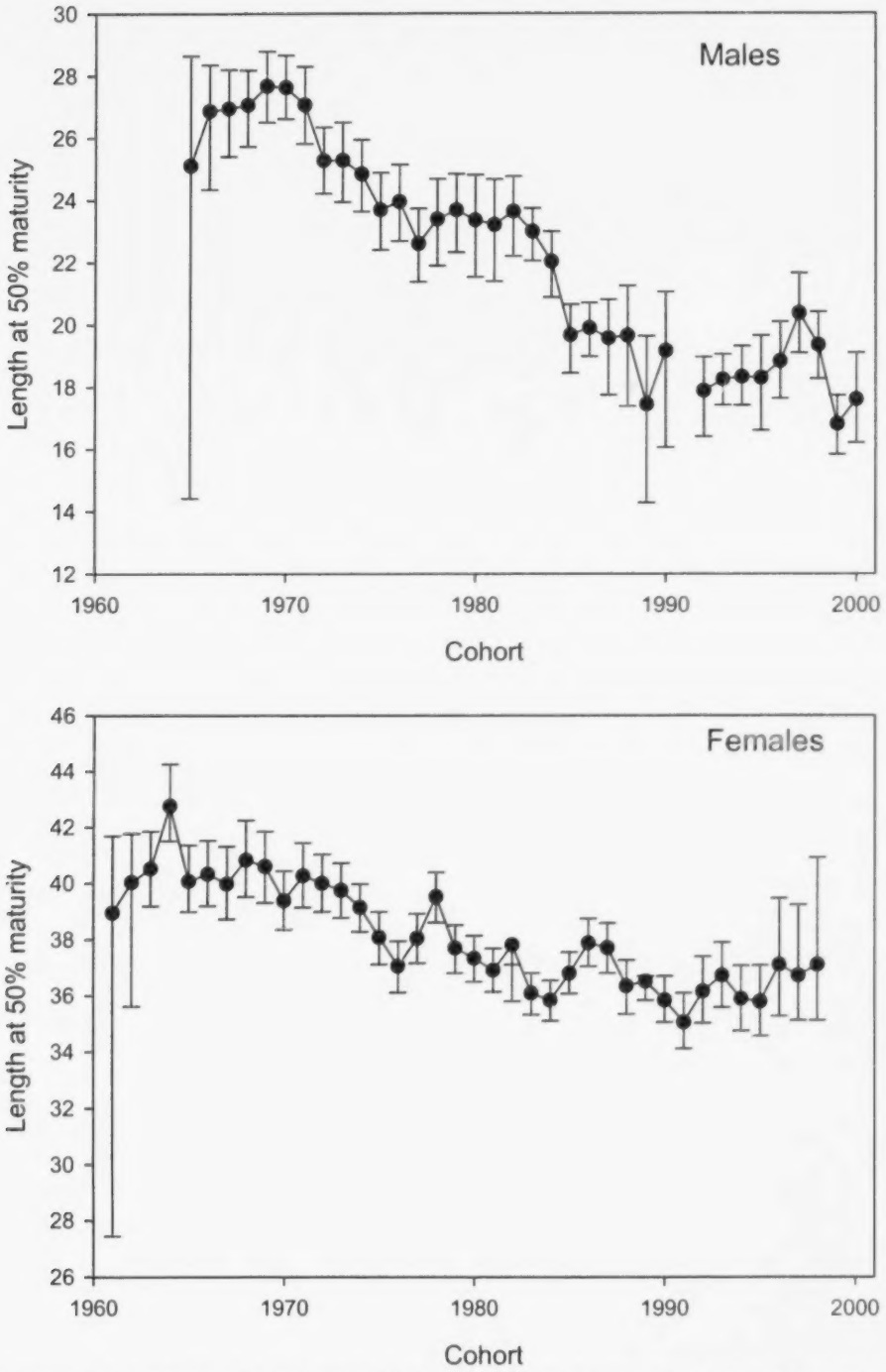


Figure 16. Length at 50% maturity by cohort for male and female American plaice from research vessel surveys in Subdivision 3Ps.

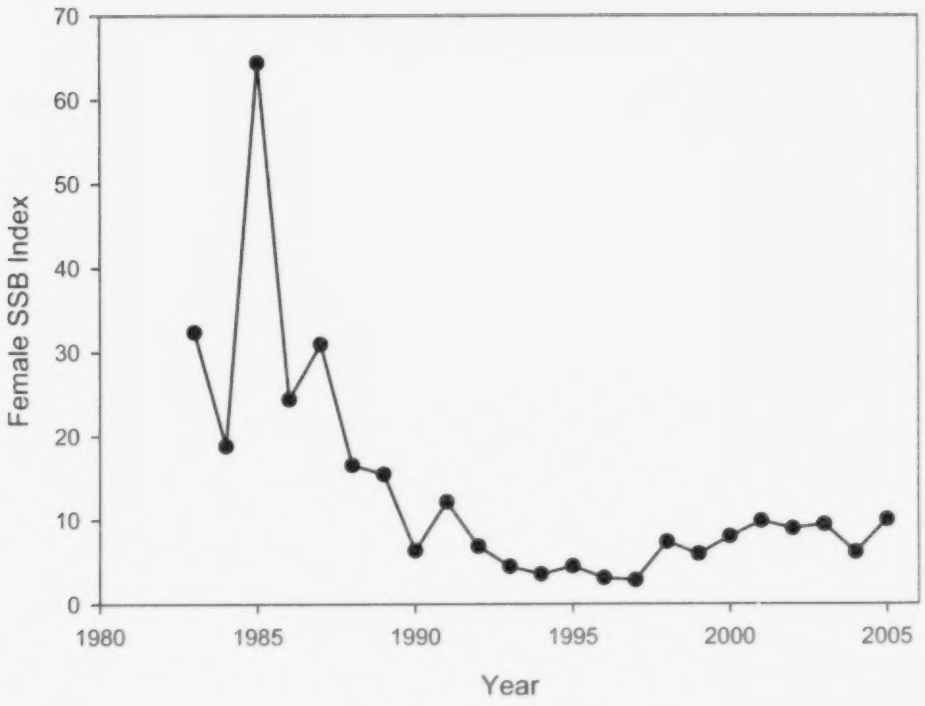


Figure 17. Index of female spawning stock biomass of American plaice from research vessel surveys in Subdivision 3Ps from 1983 to 2005.

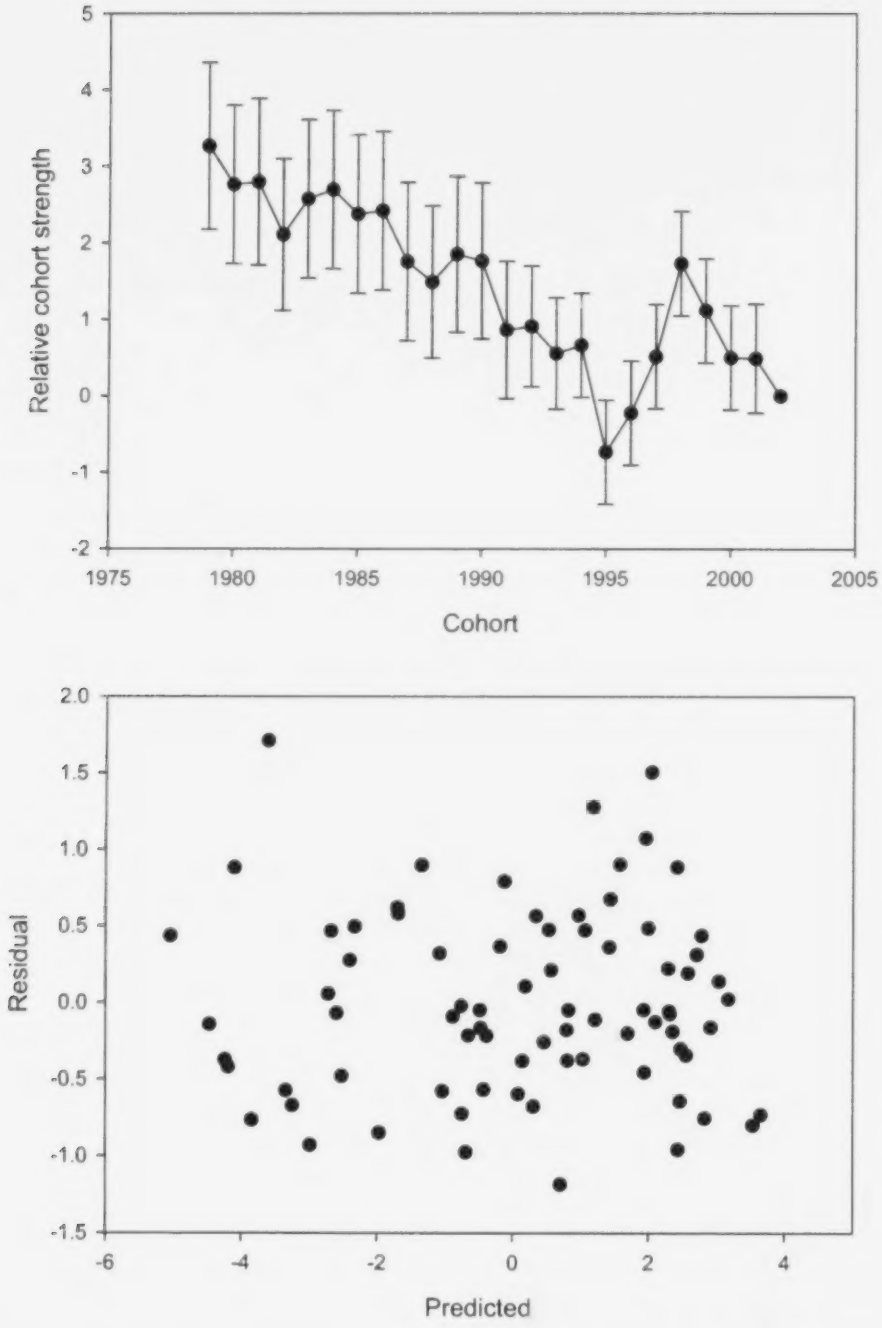


Figure 18. Relative cohort strength (± 1 std.err.) of American plaice estimated from research vessel data. The bottom panel shows the residuals from the fitted model.

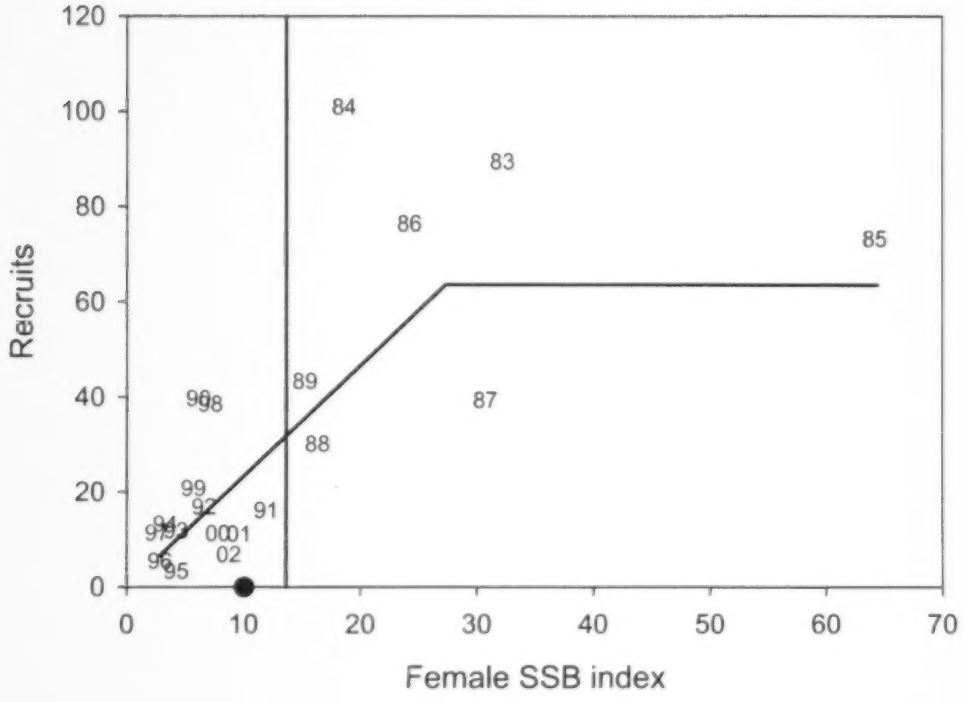


Figure 19. Relationship between recruitment and SSB as estimated from surveys for American plaice in 3Ps. The fitted changepoint regression line is shown. The vertical line shows the SSB index giving 50% of the maximum level of recruitment.

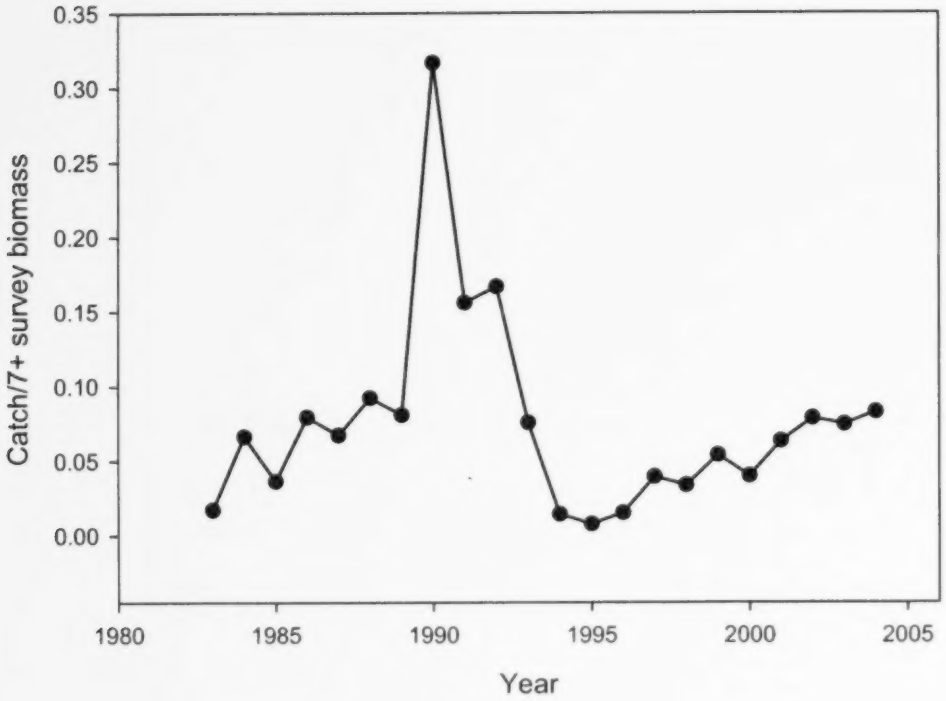


Figure 20. Catch to survey biomass ratio for American plaice in Subdivision 3Ps from 1983-2004. Biomass is 7+ or exploitable biomass from the research vessel survey.